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Headquarters
Air Force
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Peterson Air Force Base, Colorado

Commander
General C. Robert Kehler

Vice Commander
Maj Gen Thomas F. Deppe

Director of Public Affairs
Lt Col Michael Pierson

Creative Editor
Ms. Nadine Sage

High Frontier Staff

Lt Col Scott Maethner
Dr. Corvin Connolly
Dr. Rick Sturdevant
Mr. Masao Doi
Maj Catie Hague

AFSPC/PA
150 Vandenberg St. Ste 1105
Peterson AFB, CO 80914
Telephone: (719) 554-3731
Fax: (719) 554-6013

For more information on space professional development please visit:
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Cover: Foreground, Tech Sgt Robert Gonder, Space Cell noncommissioned officer in charge. Background, Mr. Greg Randlett, Space Cell duty technician.
Courtesy: Photo by Staff Sgt Markus Maier, US Central Command Air Forces Public Affairs

Back Cover: Space assets such as the GPS satellite system provide our armed forces with a strategic high ground during military operations.
Courtesy: STK graphic courtesy of Analytical Graphics, Inc.

HIGH FRONTIER

The Journal for Space & Missile Professionals

February 2008 Volume 4, Number 2

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Next Issue: ***Space-Based Positioning, Navigation, and Timing***

Introduction

General C. Robert Kehler
Commander, Air Force Space Command

"Our space capabilities are an hourly element of waging and winning the Long War."
~ General T. Michael Moseley, US Air Force chief of staff

I cannot think of a better subject for my first *High Frontier Journal* introduction as the Air Force Space Command commander than *"Space and the Joint Fight."* Our mission statement—**deliver space and missile capabilities to America and its warfighting commands**—highlights our focus on the joint fight. Space power shapes the American approach to warfare. Both friend and foe alike know that space forces are integral to combat operations and empower our joint military forces and allies with game-changing capabilities.

Two senior US Air Force warriors who can articulate the value of space forces in the current fight are Lt Gen Gary North and Col John Riordan. As the US Central Command Air Forces (USCENTAF) commander and director of space forces (DIRSPACEFOR), respectively, they kick off this issue with a fascinating look at how space operations are integrated and synchronized in today's combat environment. In Air Force Space Command, we not only deliver space capabilities for the joint fight, we also deliver space-experienced Airmen to other joint warfighters. Brig Gen Donald Alston, a career space and missile operator and leader, captures his experiences in Iraq as the director of strategic communications and coalition spokesman for Multi-National Forces-Iraq (MNF-I) and relates how a dynamic combat environment forges a warrior ethos. In the next article, former USCENTAF DIRSPACEFOR, Brig Gen John Hyten emphasizes how space capabilities have reached a high point in joint integration, but face increasing challenges in a contested environment. He stresses diligence and the need to adapt space organization and doctrine accordingly. Finally, Brig Gen James Kowalski, Joint Staff deputy director for Global Operations, describes how space forces provide war-winning advantages to the joint force and are a key element in our national military strategy.

In our "Industry Perspective" section, Ms. Lorraine Martin, vice president, Flight Solutions, Lockheed Martin Simulation, Training and Support, asserts that successfully protecting our space capabilities in a contested domain first requires realistic training within a robust, simulated environment.

Leading off the "Space and the Joint Fight" segment of this issue, another prior USCENTAF DIRSPACEFOR, Col Jay Raymond, and previously deployed space weapons officer, Maj Troy Endicott, describe the global nature of space capabilities and that successful coordination and integration into combat operations requires space professionals around the world in forward and reachback locations. Two other space weapons officers, Majors John Thomas and Richard Operhall, discuss their experiences as deployed planners in the MNF-I Air Component Coordination Element in Baghdad, Iraq. In their article, they capture the value of having Air Force space experts co-located with ground forces to ensure effective integration of interconnected warfighting domains. Next, Lt Col Michael Mras, Air Force Tactical Exploitation of National Capabilities director of staff, outlines past and present successes from a team dedicated to providing innovative space-based capabilities and support to tactical warfighters, intelligence, and space professionals worldwide. Lt Col George Farfour and Maj Kenneth Yee from the Space Innovation and Development Center present a thought-provoking essay on the pervasive use of space capabilities in a joint fight and within a global enterprise, and make a case for the crucial need to protect those capabilities.

We are also proud to highlight an article by Maj Charles Galbreath based on his 2007 Air Command and Staff College paper that garnered the institution's Space Research Award. Major Galbreath presents a well-developed composition on integrating space across all warfighting domains, and inspires dialogue on further development of a joint space concept. In the final article of this edition, Maj Heather Yates from the National Reconnaissance Office and Dr. Michael Grimaila from the Air Force Institute of Technology skillfully draw upon best practices from the information security realm and apply them to the space domain.

I join a grateful nation in thanking those in the military, industry, and our space community who contribute each day to the joint fight and help us achieve our vision as **America's space leaders … delivering responsive, assured, decisive space power.**

I hope you enjoy this and future issues of the *High Frontier Journal* and use them as part of your own space professional development regimen. The theme of our next issue is "Space-Based Positioning, Navigation, and Timing." I encourage you to submit articles that spur discussion by illustrating the widespread impact of our global positioning system and future challenges to this most prominent, worldwide utility.

General C. Robert "Bob" Kehler (BS, Education, Pennsylvania State University; MS, Public Administration, University of Oklahoma; MA, National Security and Strategic Studies, Naval War College, Newport, Rhode Island) is commander, Air Force Space Command (AFSPC), Peterson AFB, Colorado. He is responsible for the development, acquisition, and operation of the Air Force's space and missile systems. The general oversees a global network of satellite command and control, communications, missile warning and launch facilities, and ensures the combat readiness of America's intercontinental ballistic missile force. He leads more than 39,700 space professionals who provide combat forces and capabilities to North American Aerospace Defense Command and US Strategic Command (USSTRATCOM).

General Kehler has commanded at the squadron, group, and twice at the wing level, and has a broad range of operational and command tours in ICBM operations, space launch, space operations, missile warning, and space control. The general has served on the AFSPC Staff, Air Staff, and Joint Staff and served as the director of the National Security Space Office. Prior to assuming his current position, General Kehler was the deputy commander, USSTRATCOM, where he helped provide the President and Secretary of Defense with a broad range of strategic capabilities and options for the joint warfighter through several diverse mission areas, including space operations, integrated missile defense, computer network operations, and global strike.

The Role of Space in Military Operations:
Integrating and Synchronizing Space in Today's Fight

Lt Gen Gary L. North
Commander, 9th Air Force and
US Central Command Air Forces
Shaw AFB, South Carolina

Col John Riordan
Director of Space Forces
Combined Air Operations Center
US Central Command Air Forces, Southwest Asia

The practical application of space in air, ground, and maritime operations is frequently misunderstood. In many cases, it is taken for granted that space effects will be present when needed. In the worst cases, space effects are dismissed by many as too difficult to coordinate and not worth the effort. Space effects are available and will remain a key and critical component in the synchronization and integration of ongoing and future operations, in a wide range of applications, from humanitarian to major combat operations.

Space planning and operations transcend the traditional strategic, operational, and tactical levels of war, enabling friendly forces to see, hear, know, and act first. Correctly integrating space into military operations is well worth the effort, and is contributing greatly to the desired effect of defeating insurgents and stabilizing Iraq and Afghanistan. This article presents two real-world vignettes highlighting space in today's fight, and should serve to clear away some of the mystery surrounding the processes and procedures used to provide space effects. It also highlights the immense importance that space plays in everyday military operations. Prior to the vignettes, it's important to set the stage with a basic overview of the space construct in the US Central Command (CENTCOM) theater.

The commander of CENTCOM delegated space coordination authority (SCA) to the combined force air component commander (CFACC) for Operations Iraqi Freedom and Enduring Freedom. This authority requires integrating and synchronizing space capabilities into the fight throughout the CENTCOM area of responsibility (AOR). As the CFACC, the commander of US CENTCOM Air Forces (CENTAF), runs the air war in the CENTCOM AOR through the combined air and space operations center (CAOC) in Southwest Asia. Because he is assigned SCA, he gathers and addresses space requirements from the entire theater, including coalition partners. These requirements are captured in space support requests (SSR) that are sent to the CAOC staff for resolution. The CENTAF director of space forces (DIRSPACEFOR) and a staff of five space experts work to fulfill SSRs, and coordinate and synchronize space effects. The DIRSPACEFOR is responsible for day-to-day space operations integration, planning, and synchronization into the air tasking order. This position, a one-year rotational remote deployment position, adds valuable continuity to the space planning efforts in theater. The CAOC combat operations division Space (COD Space) cell then uses a combination of in-theater space expertise and stateside capabilities to provide the required space effects during execution.

The US Army also has embedded space experts throughout the theater in both Army space support teams and space support elements. These teams and elements are fully involved in planning tactical Army and Marine operations and are the main producers of SSRs. The CENTAF space team works very closely with Army space professionals to ensure the full spectrum of space effects is understood and incorporated into planning processes. In addition, the Air Force has strategically placed several of our most highly trained space experts—space weapons officers (SWO)—throughout the AOR. Five SWOs are currently in theater conducting space planning and operations, including two at the CAOC and one each at the Multi-National Forces-Iraq headquarters in Baghdad, the Marine expeditionary force headquarters in western Iraq, and the International Security Assistance Force headquarters in Afghanistan. In total, nearly 90 Air Force, Army, and Navy space personnel are currently in theater working to provide space effects to air, ground, and maritime commanders.

The following real world vignettes highlight the planning and execution of military operations in the CENTCOM theater, and show how space effects are not only integrated and synchronized in the CAOC, but are also critical enablers of air and ground operations. The concepts discussed in these narratives apply to nearly every type of military operation conducted today.

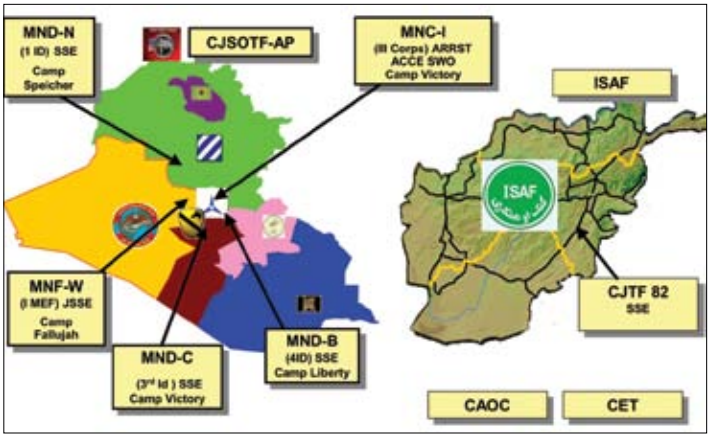

Figure 2. Space Forces Map for Iraq and Afghanistan.

Vignette #1: Weapons Cache Raid—Afghanistan

Maj Denny Roscoe, an Army space officer deployed to Bagram, Afghanistan, begins his morning with a daily deliberate operations planning meeting at division headquarters. Halfway through the meeting, the special forces representative outlines a planned operation to raid a suspected insurgent weapons cache southeast of Khost in five days. According to intelligence sources, the cache may be located on the property of a local villager, but its exact location is unknown. As inputs are given and courses of action discussed, the lead planner asks, "What can *space* do for us on this one?" Major Roscoe lays out a few options—imagery, satellite communications (SATCOM), weather predictions, GPS accuracy predictions and enhancements, and possibly improvised explosive device (IED) detection from space. He tells the planner that his team will begin planning space effects for the operation and will get in contact with the CAOC to see if there are any additional possibilities.

The first effect that will be of utmost importance is current imagery. He provides the planners with a few space-based images he already has of the area, but he knows the value of change detection in imagery. So he sends a request to the commercial exploitation team (CET) to find out if it has any recent commercial imagery of the area. The CET is an Army unit that maintains a large database of commercial space imagery and provides this imagery to the warfighter upon request. His plan is to see if there are any recent changes on the property that might indicate the location of the cache.

While he's waiting for the imagery, he constructs an SSR to send to the CAOC, requesting the GPS signal be optimized for the execution window. GPS is generally extremely accurate; however, he wants to mitigate any risk that handheld GPS receivers may produce inaccurate coordinates. In addition, he wants to ensure GPS-aided munitions from CFACC airborne assets are optimized.

Furthermore, he submits an SSR for a weather mosaic of the area from space-based overhead non-imaging infrared (ONIR) sensors shortly prior to the execution window. This will give the planners a good idea of cloud cover and weather in the area that may impact helicopter operations in the event of a personnel recovery mission. He also plans to look at the predicted space weather for the time period to make sure that there are no solar or space weather events that may impact SATCOM. Finally, he knows there is a possibility that insurgents have placed IEDs along the route, so he submits an SSR requesting any available space-based assets to look at the ingress route for the team to see if there are any obvious signs of IED emplacements.

The following morning the DIRSPACEFOR theater space integration planner, Capt Tori Charles, finds the SSRs from Major Roscoe in her inbox. She immediately begins to process the SSRs and determines what can be done in theater and what needs to be sent stateside for reachback support. She checks to make sure each SSR contains all the information needed to provide the effect, and that each is clear and unambiguous. She then routes the GPS enhancement SSR back to the Joint Space Operations Center (JSpOC) at Vandenberg AFB, California. As the single reachback agency for theater user space support, the JSpOC determines what agency or unit can best support the request and then forwards the tasker for action. The JSpOC sends the SSR to the 2nd Space Operations Squadron (2 SOPS) at Schriever AFB, Colorado. The squadron is responsible for "flying" the GPS constellation on a day-to-day basis and ensuring it is as accurate as possible. There, a mission planning cell convenes and begins to investigate options for ensuring GPS is optimized during the execution window.

Figure 3. GPS, IIR-M Satellite.

In the meantime, Captain Charles also sends the weather mosaic SSR back to the JSpOC, which in turn routes it to the appropriate satellite ground station for processing and collection during the requested window. She then works with the CAOC Intelligence, Surveillance, and Reconnaissance Division (ISRD) on the final SSR—using intelligence assets to search for IEDs along the ingress route. The ISRD collection manager submits requests for space-based assets to collect on the area each day until the operation.

Captain Charles then pulls up the Space Battle Management Core System (SBMCS) used to model how GPS accuracy will look during the execution time period. As expected, the model shows no accuracy issues for that day, so Captain Charles sends word back to Major Roscoe that GPS looks good for the window. She also passes this information on to the CAOC combat plans division so its people can be assured that the aircraft and weapons they will schedule to be overhead during the raid will have accurate GPS.

Operational planning continues the following afternoon at the division, and Major Roscoe begins receiving responses to the SSRs he submitted. The JSpOC responds that 2 SOPS has accomplished appropriate procedures to ensure GPS will be as accurate as possible during the raid. He also receives a response that the ONIR weather mosaic will be available for him about four hours prior to the raid, so the special forces team will have one last chance to take a look at the weather to support the

"go/no-go" call.

The CET also sent him imagery of the area, including pictures from about two months prior and a more recent picture from 10 days prior. With some help from his imagery analysts, Major Roscoe determines that there has been some apparent digging in the northwest corner of the targeted property, and a new shed has been constructed in the area. He suspects that this may be the location of the cache that his sources reported. This will be the first place the special forces team search during the raid. This also allows the team to re-evaluate their avenue of approach, now that they know where the cache may be located.

At the CAOC, Captain Charles receives a call from the CAOC's ISRD that no evidence of IED emplacement was found in the initial intelligence collection products. She relays this on to Major Roscoe. This is a good sign; however they know that insurgents may emplace IEDs at any time so they will still need to be cautious. They will continue to check the products daily for any suspicious activity.

By that evening, the combat plans division at the CAOC has planned the armed overwatch for the operation; they will have two F-15E Strike Eagles overhead with GPS's guided Joint Direct Attack Munitions (JDAM) on board in case the ground commander needs support from the air.

By 1700 the next evening, the planning is complete. The leadership receives its final briefings on the raid, and rehearsals begin. Major Roscoe is only waiting for the final weather mosaic to give the special forces team one last look at the weather before the operation commences. At 2200 the ONIR weather mosaic comes in and the planners take a look. The area of the raid is clear, so they give the team a thumbs up and get ready to move out.

Three hours later, at 0100, two F-15Es take off from a base in eastern Afghanistan in order to be overhead in time for the raid.

At 0145 the F-15Es arrive in the area, but remain back in order to not tip off the enemy. The weapon systems officer (WSO) in each aircraft check their GPS receivers and notes they have good signals and that the JDAM munitions loaded on the aircraft are fully functional.

At 0200 the special forces team begins to move. The team is accompanied by an Air Force joint terminal attack controller (JTAC)—an Airman embedded with Army units and trained to coordinate air strikes. As the team passes through the village the lead vehicle identifies an unusual bump ahead of them on the side of the road and stops to investigate, suspecting it may be an IED. While they are stopped they come under small arms fire from a nearby wooded area between two houses. They suspect the small arms fire is an attempt to get them moving again, possibly into another IED, so they stay put for the moment and return fire. Knowing that their element of surprise is gone, they begin to run through their options for eliminating the threat from the woods. As the firefight wears on, the ground commander tells the JTAC to call in an air strike on the enemy position. The JTAC immediately calls the F-15Es and begins coordinating a possible kinetic strike.

After running through a rigorous process to minimize collateral damage, the ground commander authorizes the air strike. The F-15E WSO checks his GPS one final time, notes it is good, and drops a 500 lb. Guided Bomb Unit-38 JDAM on the enemy position. As the JDAM comes off the wing, the GPS receiver in the tail of the weapon picks up the GPS satellite signal and begins to input its position into the inertial navigation system on the bomb. The GPS-aided navigation system guides the bomb as it falls, and the JTAC watches as the weapon scores a direct hit on the firing position in the trees. After reporting to the F-15E that it has a good hit, the JTAC notes no further small arms fire coming from the woods. The team verifies that the combatants were killed, and they mark the IED location for their explosive ordnance disposal experts to disarm. Then they move on toward the original target—the weapons cache.

Upon arriving at the targeted property, they move to investigate the shed shown on the imagery. Inside they discover a false floor hiding nearly 50 mortar rounds and components for making dozens of IEDs. After carefully inventorying the cache, they wire it with explosives and destroy the hidden weapons. As the team returns home, they inventory their supplies and find that they are dangerously low on ammunition due to the extended firefight in the village. Their radio operator calls in via SATCOM to report their status and request an emergency resupply airdrop for ammunition. The Air Mobility Division at the CAOC reprioritizes missions for the night and schedules a

Figure 4. Joint Terminal Attack Controller.

Figure 5. Joint Precision Air Drop System.

C-130 to perform an emergency airdrop to the team.

As the C-130 prepares to take off, it is loaded with a special pallet of ammunition. This pallet is a Joint Precision Air Drop System (JPADS), a specially designed airdrop pallet that uses GPS integrated into a steerable parachute system to deliver the pallet exactly where it needs to go. If the pallet were to miss by even 100 meters, it may fall into enemy hands. The CAOC combat operations division checks with the COD Space cell to ensure GPS will be optimized for the airdrop, and after checking their computer model, they find that GPS looks good for the drop time and location. Three hours later, the JPADS acquires the GPS signal as it is released out of the back of the C-130, and it guides directly to the location where the special operations team is waiting. The resupply is successful, and the team is ready for the next mission.

Vignette #2: Hunt for High-value Individual—Iraq

Lt Col Aiden Mack is the chief of the Army space support team working in northern Iraq. He is called in to a meeting to help plan a raid on a house in the middle of a large neighborhood in Kirkuk where a high-value individual (HVI) may be hiding. Along with setting up imagery collection requests and weather predictions, he also submits an SSR for GPS enhancement in the target area. He knows that a Guided Multiple Launch Rocket System (GMLRS) is stationed in the area, and that it uses GPS to guide its rockets, so he wants to be sure the warheads are as accurate as possible to mitigate collateral damage.

His next action is to ensure that the blue force tracker (BFT) architecture is set up to track friendly team members as they execute the raid. The team's vehicles will have attached BFT devices which receive the GPS signal, calculate their exact position, and send this data back through satellites to their leadership so they can see where the troops are located. Colonel Mack calls back to the BFT management center to make sure its aware of the operation and which BFT devices will be used. The center confirms the information and affirms that its people will be watching as the operation unfolds.

At the CAOC, Captain Charles processes the SSRs and, after speaking with the combat plans division, determines that an MQ-1B Predator unmanned aerial vehicle is scheduled to be overhead during the raid. Since the Predator is flown via SATCOM and also streams full-motion video to the CAOC via a SATCOM link, Captain Charles knows that protecting those links is extremely important. She makes a call to COD Space and asks them to contact Silent Sentry, a deployed Air Force Space Command unit that monitors SATCOM links for interference—intentional or unintentional—on selected frequencies. Silent Sentry uses multiple ground-based satellite antennas to monitor the signals, and, if interference is noted, geolocates the source of interference so that it can be mitigated. She wants to ensure that Silent Sentry will be monitoring the Predator SATCOM frequencies for interference. COD Space also passes on the priority SATCOM frequencies that the HVI team will be using so that Silent Sentry can monitor those as well. Silent Sentry assures her that they will be monitoring those frequencies, and Captain Charles passes this on to Colonel Mack and the ISRD for their awareness.

The next morning COD Space receives an alert message from the GPS Operations Center at Schriever AFB that there has been an unexpected satellite anomaly. One of the GPS satellites has been taken off the air until an error can be corrected. COD Space passes the word out to the entire theater, and then immediately runs a GPS navigation accuracy model to see the impact of the outage. The satellite outage has caused a large GPS error during the middle of the execution window for the HVI raid. They call Colonel Mack to relay the change in status, and pass on a recommendation that the operation be delayed by one hour to ensure it is executed outside the time period of the GPS error. Colonel Mack and the lead planner for the operation agree that delaying one hour will not adversely impact the plan. They change the time, and pass the word back to the CAOC to adjust the flight time for the Predator.

The night of the operation arrives, and at 0215 the Predator heads north from central Iraq where it was performing countermortar operations in Baghdad. Silent Sentry verifies that they are watching the correct frequencies, and they currently see no interference on the signals. COD Space does one last check of the GPS constellation and sees no further impacts to accuracy.

At 0305 the Predator, flown via SATCOM from Creech AFB, Nevada, arrives in the area and begins orbiting overhead. The full motion video begins streaming over the SATCOM link to the CAOC, giving them a picture of the situation. The BFT management center confirms that it has good signals and is tracking the team as they arrive in the village area.

At 0325 the HVI team approaches the house. A small pickup truck emerges from the garage and speeds down the road away from the team. There appear to be three passengers in the truck, and as it flees they call to have the Predator follow the truck, suspecting one of the passengers may be the HVI. The Predator turns to follow the pickup truck fleeing the area and the team moves to the house. After clearing every room, using secure satellite communications they pass the word on to the CAOC that the HVI was not present in the house, so the CAOC shifts focus to the fleeing truck.

Now approximately 20 miles away, the Predator continues to stream video of the fleeing pickup truck. The Predator operators follow it through an uninhabited rural area to a small building hidden in a palm grove. The three passengers exit the truck and

Figure 6. Silent Sentry.

Figure 7. MQ-1 Predator.

enter the building. Since the Predator has relayed exactly where the building is located, a small Army scout team soon arrives and they are able to get eyes on the building while remaining hidden in the trees. They verify that the HVI is indeed one of the people in the building, and they also note that the men appear to be preparing for a battle. Multiple guns are seen through the windows and the men begin sandbagging the windows and doors as they set up to fight. Rather than risk lives assaulting the barricaded structure, the scout team calls for a GMLRS strike on the building where the HVI is now hiding. The CAOC searches the area with the Predator to ensure there are no other friendly individuals in the area, and the ground commander determines that there will be no collateral damage as the structure is miles from any other buildings. The GMLRS battery inputs the coordinates relayed by the team and checks the GPS. The signal remains good, and they launch a rocket toward the target. The rocket receives the GPS signal in flight, and the GPS-aided navigation system guides it to the house. The scout team moves in and verifies that the insurgents, including the HVI, have been killed.

Epilogue

These events covered only two types of operations—two of dozens that are occurring every day in the CENTCOM theater. In nearly every type of operation, space plays an integral part. Without the capabilities discussed, and without our expert space personnel in theater, we would be unable to perform any of the tasks required. The space professionals of all the armed services, along with the supporting units back in the United States, bring a capability to our military that no other country can match—the ability to successfully integrate and synchronize space effects into the fight. This non-kinetic force multiplier has become an indispensable part of our military operations.

Lt Gen Gary L. North is commander, 9th Air Force and US Central Command Air Forces, Shaw AFB, South Carolina. The command comprises five wings in the eastern United States and three direct reporting units, with more than 350 aircraft and 24,000 active-duty and civilian personnel. He is also responsible for the operational readiness of 189th Air Force-gained National Guard and Air Force Reserve units comprising the Air Reserve Component. As the air component commander for US Central Command, the general is responsible for developing contingency plans and conducting air operations in a 27-nation area of responsibility, covering Central and Southwest Asia and the Horn of Africa.

General North was commissioned in 1976 after completing East Carolina University's ROTC program as a distinguished graduate. He has held numerous operational, command and staff positions, and has completed seven overseas tours. His last assignment was the director for operations at US Pacific Command. The general has served two tours on the Joint Staff, including executive assistant to the Joint Staff director, and director of Politico-Military Affairs for Asia-Pacific where he was responsible for regional planning and policy for the Asia-Pacific, South Asia, and Central Asia regions. He also served as deputy director of Joint Matters at Headquarters US Air Force.

General North has commanded the 33rd Fighter Squadron at Shaw AFB, South Carolina; 35th Operations Group at Misawa AB, Japan; 8th Fighter Wing at Kunsan AB, South Korea; and the 18th Wing at Kadena AB, Japan. He is a command pilot with more than 4,100 flying hours, primarily in the F-4, F-15, and F-16. He flew 54 combat missions during Operations Desert Storm and Southern Watch.

Col John Riordan (BA, Economics, Montclair State University, Upper Montclair, New Jersey; MBA, Business Administration, Regis University, Colorado; MS National Security Studies, National War College, Washington DC) is presently assigned and deployed as the director of space forces, combined air operations center, United States Central Command Air Forces, Southwest Asia. Previously, Colonel Riordan was commander of the 595th Space Group, Space Innovation and Development Center, Schriever AFB, Colorado. He has also been the commander of the 741st Missile Squadron, 91st Space Wing, Minot AFB, North Dakota. Colonel Riordan served as deputy executive assistant to General Richard Myers, USAF, and General Peter Pace, USMC, the vice chairman of the Joint Chiefs of Staff. Colonel Riordan served on the Joint Staff as the assistant chief of the Joint Requirements Oversight Council Secretariat, as well as the executive assistant to the director for force structure, resources, and assessment.

Outside My Comfort Zone, Inside the Green Zone

Brig Gen C. Donald Alston
Director, Space and Nuclear Operations
Deputy Chief of Staff,
Air Space and Information Operations
Headquarters Air Force
Pentagon, Washington, DC

"Sir, my name is Louis, and I am your bodyguard." I imagine other folks hear greetings such as, "welcome to Iraq" as the first words they hear in country, but that was not the case for me.

The date was 7 February 2005, and it was just 17 days after I was announced to be the next director of strategic communications and coalition spokesman for the Multi-National Force-Iraq (MNF-I). I had just walked from the C-17 that had taken me on an air-refueled, five-hour flight directly from Frankfurt, Germany, to Baghdad International Airport. It was dark, about 1930 hours and well after sunset, when my assigned personal security detail and I loaded my luggage in the back of an up-armored HMMWV (or humvee) … then, we loaded our weapons. We were departing Baghdad International, adjacent to Camp Victory, and en route to the building complex where I would find both my office and my "hooch" (living quarters) for the next year. Our destination was the Republican Palace on the western bank of the Tigris River in the geographic center of the Iraqi capital. This was my first of many dozen trips down the Airport Road, also known as Route Irish. The fastest year of my life had begun.

Figure 1. Weekly Media Briefing, Baghdad, Iraq.

I had served in the Air Force nearly 27 years and this was the beginning of my first overseas assignment. As the first 365-day director of strategic communications (and the second ever in the Department of Defense [DoD]), I would be performing way outside my comfort zone in a duty unlike any other I had ever performed. I kept asking myself, "How does a career space and missile operator find himself in downtown Baghdad briefing Iraq's national security advisor (NSA) and synchronizing details with the prime minister's spokesman every day, among other things?" One thing was clear … I was a long way from "Eddie's Corner" and the missile fields of Montana.

First off, let me make it clear that this article is not intended to be a war journal. I served for a year in a senior staff position working for the four-star MNF-I commander and my perspective is centered on that experience. There are plenty of other brave men and women, US, Iraqi, or coalition partners, who could provide a much more intriguing and enlightening perspective of what combat on the ground in Iraq is like. My goal here is to simply share some of my experiences and observations in the hope that something here may prove useful to you, the space professional, as you prepare for your next deployment.

Pre-Departure—Prepare to Redefine Your 'Comfort Zone'

On 14 December 2004, the Commander of Air Force Space Command (AFSPC), General Lance W. Lord, brought me into his office and informed me of the impending assignment. As a previous wing commander, I supported many folks going down range, but now I was about to become one of those supported. I was going to be the deputy J3 for communications, to include duties as spokesman for the coalition. I was not sure what those duties would entail or when I would be required to be in country, but it was evident I had a few days, maybe a few weeks, to figure it out. Fortunately, this type of short-notice assignment is not typical, but the fundamental lesson here is that if you are putting on a uniform every day, *your bags had better be handy and you better be prepared to redefine your 'comfort zone' … FAST!*

Soon after the deployment process was in motion, the job changed from communications to strategic communications. Some initial research told me that at the most basic level, the job included public affairs (PA), information operations (IO), and something called defense support to public diplomacy (DSPD). The PA piece was the largest of the three and included constant engagement with all media and telling our story through the distribution of press releases, press conferences, television, radio, and print media interviews, as well as daily engagement with Iraqi, regional, and international press personnel. We also had responsibility for a radio broadcast and a television component that produced a daily show entitled, "Freedom Journal Iraq." Textbook IO, by definition, includes computer network operations, psychological operations, military deception, operations security, and electronic warfare, though our capacity in several of these areas was not robust. Finally, the DSPD piece included

Figure 2. General Alston and Iraqi National Security Advisors.

The important lesson here is: you will integrate faster if you are in synch with the dominant operating culture.

daily contact with the Iraqi government, specifically daily briefings with Iraq's NSA, the Minister of State for National Security Affairs, the NSA's senior staff, the prime minister's spokesman and creating a functional relationship from scratch with the ministry of defense and the ministry of the interior to help them develop PA capacity.

Strategic communications was not exactly a new concept, but, much to my surprise, nowhere in the DoD was there anything like the set-up in Iraq. This made preparation back home problematic, so I took to learning what I could with the short time I had left before my departure. I visited the Chairman of the Joint Chiefs of Staff public affairs officer and other relevant agencies, and enrolled in a special operations command course on IO. The rest I would have to pick up on the job. I quickly realized the new position would require skills in areas where I was less than a seasoned veteran, to say the least. As I began to mentally prepare myself for the deployment, I also began to wonder whether I was physically prepared to go into a combat zone.

As you prepare for deployment, I encourage you to ask yourself these questions: are you in good enough shape to take care of yourself in full battle rattle, or will you put someone at risk because you are not? If you are qualified on your weapon before you deploy, can you function effectively off the shooting range? In short, most space and missile operators do not have the ground combat operations instincts drawn from years of experience. Depending on your job, you may receive a great deal of training before you depart, but even if that's the case, tactics, techniques, and procedures (TTP) evolve all the time. Ask questions and practice before you go outside the wire—there are a lot of mutual dependencies on the ground.

As my preparation time rapidly drew to a close, I also began to analyze my preparedness for joint warfighting. I realized early that I was heading deep into a foreign culture—the US Army! I certainly mean no offense to my Army brothers and sisters as their service and commitment is both legendary and unimpeachable. But my 'joint time' on the US Space Command staff did little to prepare me for the looming challenges ahead. The simple fact is, for all of our improvements in 'jointness' in recent years, service cultures are different and Airmen need to be prepared for that. The important lesson here is: *you will integrate faster if you are in synch with the dominant operating culture.* Previous joint schools or joint positions can contribute to your network of buddies who can provide tips to help you merge faster. You are an Airman and you will bring an Airman's perspective; but for my assignment, the communication channels were Army communication channels, and the reality was I was supporting Army leaders running a ground-centric campaign plan—still one more adjustment to my 'comfort zone.'

Finally, perhaps the most obvious deployment consideration with which I had to contend was the fact that I was heading into an Arab country and an Arab culture. With only days of preparation, I had very little time to get any useful insight from anyone—and the process, much to my surprise, did not service this need. It is a gross understatement to say we can project unintended arrogance if we are not hypersensitive to the host culture and norms. I can remember being in a room with Iraqis listening to other Americans speak as if the Iraqis could not talk for themselves. My 2005 experience was that this behavior was both costly and common. I encourage all our space professionals to take advantage of the many foreign language, cultural awareness, and international security cooperation programs offered across the DoD. People who seek out relevant opportunities like these often have a leg up in coalition operations. Bottom line: *be prepared to redefine your comfort zone!*

Long Days/Quick Year … and Constant Change

In the 1993 movie, "Ground Hog Day," a weatherman relives the same day over and over again. I have heard folks refer to some military experiences or certain enduring operations as 'ground hog day,' indicating a similarity between one day and the next. I must say, this definitely does not describe my experience in Iraq. For many reasons, every day was different. Even though we have been in Afghanistan for more than six years and nearly five years in Iraq, I would still presume the connection between the routine and repetitive is loose at best. The main lesson here is: *battle rhythm and the urgent demands of combat operations drive constant change!* If anything was constant in the 365 days I spent in Iraq, it was change. Allow me to summarize my experiences 'in country' with a few broad observations regarding this subject.

For the variables we can control, the environment is fluid and dynamic. For example, you have talked to the person you are replacing and he or she has set some expectations about what the job entails. You may have even had specific training for the job you are filling and perhaps even received some measure of 'certification' for the task ahead. Rest assured that by the time you show up, some things in the job jar will have changed and many will have done so simply because turnover injects new ideas, often bringing improvements to processes that constrain schoolhouse agility. In fact, by the time you walk in the door, the contents of your job jar may have shifted and roles and responsibilities you once thought 'binned' to someone else may now rest squarely in your lap. In many cases there is a steady stream of sequential improvements in an organization and you merge with the current upon arrival. In summary, *get used to change because it is coming one way or another!*

A week into the job consider yourself 'the old guy' and an essential part of the deployed team. Innovate! Understand doctrine, processes and related TTP. Understand the campaign plan. Challenge assumptions and think critically about the so-called 'facts' and supporting information. Out-think the enemy. If you

have conviction of a better way to do the job, drive the shift in process. *As soon as you get comfortable thinking you are part of an operation that is beyond improvement, you had better start worrying, because you are losing your combat edge.*

We may have air dominance, but that does not mean we control the entire battlespace. The good guys make progress in some places, and folks strive for new ways to secure and sustain the gains. The enemy takes active measures to try to adapt—running, fighting, and folding and raising tents. Al-Qaeda, religious sects, tribes, and criminals all sought survival or advantage on my watch. Host nation leaders seek domestic advantage and regional support. Coalition members constantly work through political realities that can have an impact on future support. The scheme of maneuver for all parties is in all domains—air, land, sea, space, cyberspace—and the uncertain force multiplier of uncertain consequence is the media. And through it all, the role you are playing must have the capacity to adapt to these shifting conditions and to successfully contribute when the conditions around many chess pieces are simultaneously and vastly different. In short, *it is an extremely complicated and diverse battlespace with an incalculable number of influencing factors*.

The main lesson to derive here is that *American success in Iraq, or in any contested environment, depends on empowering creative junior enlisted and junior officers to recognize and act on threats and opportunities when and where they present themselves*. There is no net-centric environment that can accurately account for, depict and control such a dynamic and diverse battlespace. Today, necessarily, there are many more 'strategic corporals' whose brilliant idea to fund turf and lights to rejuvenate a soccer stadium in Najaf, Iraq saves lives and secures hard-fought progress far more than the addition of any amount of military force. History has proven repeatedly that when America provides its warriors with clear strategic guidance and commander's intent that they are virtually unstoppable when adequately supported and resourced to seize the initiative. Bottom line: *Start getting comfortable with uncertainty. With an intense focus on the mission, your ability to critically analyze the environment will grow.*

Figure 3. Iraqi Government Compensation Disbursement, Jolan Park, Fallujah Iraq.

Up to this point, I have highlighted some of my experiences and lessons that may help you prepare for your next deployment. Indeed, the places and circumstances I outlined may sound a world away from the environment where you sit alert and operate your weapon system. And though you are a world away, the effects you generate pay off constantly. For the most part, you probably see your results in terms related to physical domains: air, land, sea, and space. What is less understood, and therefore poorly leveraged, is how you impact the information battlespace, the 'domain' I began fighting in February 2005. I assure you, the impact of space power can be enormous. The following is a personal example of this point.

On or about 4 May 2005, two carrier-based FA-18s were lost in the vicinity of Samarra, Iraq, about 60 miles north of Baghdad. It was approximately 2200 hours and the weather was awful with wind and rain. The question we had to answer was whether this very tragic loss was an accident or the result of hostile action. The insurgents, so far, had been fair weather fighters, so this was likely not the result of a man-portable air defense. But no one needed to know the facts more urgently than the strategic communications person charged with ensuring an accurate accounting of what had, or had not transpired.

Given my experience as a former 'basic mission ready' missile warning crew member, I made a quick call to the combat air operations center (CAOC), tracked down a space professional, and asked him if he had a "static event"—the arcane terminology describing a Defense Support Program infrared return—at a specific time and place. He immediately gave me all the essential information I needed to rapidly make my next five decisions. That is the competitive advantage of being a global spacepower! In this region and in this culture, it was my experience that the first to tell the story was in the most influential position. Seizing the initiative and gaining positional advantage in the information battlespace yields similar advantages to operations in the air or land domains. Another strategic communicator would not know to ask the question, and the keepers of the vital information would not think to push in that direction, and all of this is another commercial for net-centric operations.

This experience highlights still more lessons relevant to the current fight. First and foremost is *we need Airmen thinking Clausewitz and Sun Tzu in the information battlespace!* A second lesson that is evident here is *space integration comes in all shapes and sizes and needs to be tended to throughout the area of responsibility.* The bottom line here is that strategic communications is a team sport—everybody, at every level of war, needs to be acutely aware of that and involved at all times. Only through cross-domain, cross-agency, and cross-coalition synchronization will we maximize our impact in the information battlespace. The 'fight's on' there all the time.

These concepts are especially important in Operation Iraqi Freedom since there is no monolithic or homogenous enemy in Iraq. Back home we principally read about al-Qaeda and sectarian violence between Sunni versus Shia. The situation is

... American success in Iraq, or in any contested environment, depends on empowering creative junior enlisted and junior officers to recognize and act on threats and opportunities when and where they present themselves.

Figure 4. Taping an interview with NBC News, Baghdad, Iraq.

not so simple especially when adding Kurds, tribes, criminals, former regime members, Iran, Syria, and Turkey to the mix. Consider the extraordinary challenges of birthing a functional democracy at the village and provincial level, let alone the national level, among a population that grew up under a despotic dictatorship. From my 2005 perspective, with the players seemingly united only in their desire to deny anyone else from gaining advantage, all of them became highly skilled communicators.

From car bombs to writing java script and merging streaming jihadist music on the internet, on my watch, al-Qaeda certainly had impact. I learned a great deal every day—often from failure (one might say, "character building opportunities")—on how to operate and maneuver in this 24-hour news cycle environment. We had to keep trying to get the truth out. Certainly there was bad news, but there was also progress that we transmitted daily, only to have it ignored by the media. We fought hard to get these stories of progress out to the American people, as well as to our allies, the region, and the Iraqi people, and we were often frustrated. It would require more space than I am allowed in this article to describe some of the TTP and relationships that evolved to improve our position over the course of my year. We are getting better but this is an extraordinarily complicated, dynamic, and consequential environment that requires substantial development and although we are getting better, we have a long way to go in order to get it right.

In Conclusion—Get to the Fight!

Synchronized and integrated effects on the battlefield are a function of good, deliberate planning, vision, innovation, critical analysis, and having the capacity to meet urgent needs with a range of capabilities. Space power has proven to be a game-changer for the joint force commander and an undeniable competitive advantage for the United States. The experience gained by our space and missile operators on the ground today in Iraq, Afghanistan, and Qatar represents a deliberate human capital investment in our future space leaders to ensure we maintain our competitive advantage. There simply is no substitute for leading and problem solving under the urgent conditions of combat operations. Whether your duty is at the CAOC, in Al Anbar attached to the Marines, or outside the wire near Kandahar doing improvised explosive device post-attack analysis, the experience you gain being closer to the point of attack is vital for our Air Force and the joint fight. You cannot get this experience by proxy. As challenging as my tour of duty in Baghdad was for me and my family, I know that experience adds value to the quality of my service every day.

Brig Gen C. Donald Alston (BS, US Air Force Academy, Colorado Springs, Colorado; MBA, Business Administration, Golden Gate University, San Francisco, California) is the director, Space and Nuclear Operations, deputy chief of staff for Air, Space and Information Operations, Plans and Requirements, Headquarters (HQ) US Air Force, Washington, DC. In this capacity, General Alston is the Air Force lead for space and nuclear operations as his directorate integrates space and nuclear capabilities into Air Force, joint, coalition, multi-national, and US national security planning/operations. The directorate also provides guidance to processes involving space and missile career field development, training, qualifications and certifications, and develops and assesses spacepower employment and concepts. The general directs personnel supporting more than 300 units worldwide and programs valued at more than $104 billion.

General Alston was commissioned in 1978 following graduation from the US Air Force Academy. He has commanded a missile squadron, an operations group, and a space wing in Air Force Space Command (AFSPC). He has worked as a liaison officer to the US House of Representatives, and also performed duties as the executive assistant to the secretary of the Air Force in Washington, DC. The general has also held numerous staff positions while serving at HQ AFSPC and US Space Command.

In 2006, General Alston completed a one-year contingency operations deployment and served as the deputy chief of staff for strategic communications and the spokesperson for Multi-National Force-Iraq in Baghdad. Prior to his current assignment, he was the director of Air, Space and Information Operations, HQ AFSPC at Peterson AFB, Colorado.

The general wears the basic Parachutist badge and is a command space operator with mission-ready experience in Minuteman III and Titan ICBMs, as well as the Attack and Launch Early Reporting to Theater space-based missile warning system.

General Alston is a graduate of Squadron Officer School, Air Command and Staff College (correspondence), Air War College, Armed Forces Staff College, and the National Security Management Course at Syracuse University.

Synchronized and integrated effects on the battlefield are a function of good, deliberate planning, vision, innovation, critical analysis, and having the capacity to meet urgent needs with a range of capabilities.

Fighting and Winning with Space

Brig Gen John E. Hyten
Director of Requirements
HQ Air Force Space Command
Peterson AFB, Colorado

In May of 2006, I was privileged to deploy to Southwest Asia as the director of space forces (DIRSPACEFOR) in the combined air and space operations center (CAOC). I had deployed to a number of different theaters throughout my career in support of various exercises and wargames. Invariably, prior to 2006, I spent a great deal of my time educating and explaining why space was important to the fight. The biggest difference in 2006, besides the obvious fact that it was for real, was that I never had to take the time to do this. All I was asked to do was to advise the air component commander and bring space power to bear working to defeat a very difficult enemy. From the perspective of a 25-year career, this was extremely gratifying. Space was viewed as another combat effect and I was viewed as somebody who could help bring that effect into battle. In a joint construct, with joint leadership, space had reached the point where it was just part of the team. A great leap forward—but we still have a ways to go.

Background

In 1991, immediately following the first gulf war, the Air Force Chief of Staff, General Merrill A. McPeak dubbed that conflict "the first space war."[1] If viewed in the broadest context, it may have been, but from a space professional's perspective, we did a horrible job of integrating space into that fight—GPS was barely integrated into any Air Force aircraft, handheld receivers were hard to come by, military satellite communications (MILSATCOM) had significant bandwidth and receiver shortfalls, and space-based intelligence had a difficult time getting out from behind the green door. The potential was clearly evident and when brought to bear, space capabilities made a significant contribution—but only a few really understood it and even fewer knew how to ask for it. This is why for more than a decade we struggled to bring space effects to a theater fight and why we spent so much time educating and explaining what commanders needed to worry about and what they needed to ask for.

Today, things are certainly different, and I saw that first hand in my deployment. General C. Robert Kehler, summed it up in October 2007 when he took command of Air Force Space Command (AFSPC): "The space capabilities we provide today are embedded in all of our combat operations," he said. "They're also embedded in our military operations, short of combat, across the board. In fact, we cannot fight the way America fights today without space capabilities."[2]

So when somebody asks me how we're doing today in bringing space capabilities to the fight, I do not hesitate in responding, "pretty darn well." But I also know that we have significant challenges facing us. We have a lot of work to do—some of which is underway, some of which we haven't even started yet, and some of which we just need to agree upon and write down.

Joint Doctrine

Doctrine: (noun) a belief (or system of beliefs) accepted as authoritative by some group or school.[3]

With the tremendous advancements we have made integrating space into the joint fight, one would assume that our joint doctrine would at least adequately describe what we believe about space operations and space power. In fact, if one wanted to at least begin to understand how space power is brought to bear, they would naturally go to approved doctrine and see what our joint leadership has to say. When they reach for joint doctrine on space, they would find Joint Publication (JP) 3-14, dated 9 August 2002—fairly recent as well. However, the pace of the war and the pace of change have left our joint doctrine well behind—useful only as a time capsule in history. It is anything but "authoritative." In fact, it is either wrong or, at best, incomplete describing how to apply space power at the tactical and operational level of war.

In the five years since JP 3-14 was published, many significant things have changed. First of all, and most basically, the United States Space Command (USSPACECOM) has gone away—replaced by the United States Strategic Command (USSTRATCOM). This one change makes our current joint doctrine mostly irrelevant. Secondly, the two key methods for joint force commanders (JFCs) to obtain space support are described in JP 3-14 as: USSPACECOM liaison officers (LNOs) and joint space support teams (JSSTs). Specifically, joint doctrine today reads:

USSPACECOM LNOs may be attached to supported combatant commander staffs in order to help ensure that space-based capabilities are appropriately integrated into respective combatant commander's planning, operations, training, and execution. The coordination of routine/peacetime space support issues by USSPACECOM is conducted by the geographic combatant commander's space LNO. During crisis, and if deployed, this function is performed primarily through the JSST from USSPACECOM.

Specific examples of tailored support provided by JSSTs to JFCs include the following:

- Facilitating the distribution of missile warning data and other space-based information to the theater
- Forecasting the vulnerability of friendly operations to observation by non-US satellites
- Assisting in composing appropriate portions of concept plans and operation plans
- Deconflicting of Department of Defense (DoD) space systems requirements between the component commanders
- Providing information on foreign space reliance and methods to deny (or exploit) adversary utilization of space
- Providing detailed information on US and foreign satellite

capabilities and operational status and the threat posed by foreign space systems
- Developing space event inputs for exercises
- Advising the JFC of possible force enhancement options provided by available space systems
- Coordinating in-theater space control assets [4]

None of this exists or takes place within the joint construct today.

At least in describing command relationships, JP 3-14 describes a construct that is the basis for what exists today, although it has been modified significantly:

Theater Command and Control (C2). A supported JFC normally designates a single authority to coordinate joint theater space operations and integrate space capabilities. Based on the complexity and scope of operations, the JFC can either retain authority or designate a component commander to coordinate and integrate space operations. The JFC considers the mission, nature and duration of the operation, preponderance of space force capabilities, and the C2 capabilities (including reachback) in selecting the appropriate option. The space authority will coordinate space operations, integrate space capabilities, and have primary responsibility for in-theater joint space operations planning. The space authority will normally be supported by a JSST and will coordinate with the component SSTs and/or embedded space operators. It gathers space requirements.[5]

In US Central Command (CENTCOM) today, the commander has delegated the single authority to coordinate space to the combine forces air component commander (CFACC). This is now commonly referred to as the space coordinating authority (SCA), although SCA is not formally defined in joint doctrine.

Due to the creation of a robust CAOC the CFACC now has "the C2 capabilities (including reachback)" and the ability to C2 across the theater and back into the United States. The CAOC and the CFACC are uniquely positioned to execute the SCA responsibilities on behalf of the JFC. However, the Air Force determined that the level of space expertise in theater was not sufficient with the baseline force, and so, in support of the commander of Air Force forces (COMAFFOR), the Air Force decided to provide a senior space officer to fill this role, and this position subsequently became known as the DIRSPACEFOR.

The Air Force quickly saw the value of this position, and has codified this DIRSPACEFOR position under the COMAFFOR in Air Force doctrine. Other services immediately saw the value of this position as well, and the Army, almost simultaneously with the Air Force, decided to provide a senior officer as the deputy DIRSPACEFOR. The Army, however, looked at the DIRSPACEFOR differently. It did not provide this position to support the COMAFFOR.

The COMAFFOR's role in theater is to provide a single face to the JFC for all Air Force issues. The COMAFFOR is the single commander who conveys the commander's intent and is responsible for operating and supporting all Air Force forces assigned or attached to that joint force.[6] The Army wanted to get space capabilities to the troops on the ground across Southwest Asia—and the best place to do this was through the CFACC who had been delegated SCA. They looked at the DIRSPACEFOR as the critical link to the CFACC and SCA and that is what the DIRSPACEFOR transformed into.

Within the CENTCOM AOR the CFACC looks to the DIRSPACEFOR for advice and leadership in executing SCA responsibilities, and the Army deputy is critical to get "space" to the forces forward on the ground. The DIRSPACEFOR in CENTCOM became active in the joint fight and spends most of his or her time focused on joint warfighting problems. Very little of the DIRSPACEFOR duties are in support of the COMAFFOR. And it works extremely well.

Unfortunately, this is not supported by joint doctrine—and the DIRSPACEFOR construct in CENTCOM, proven in war, is not the standard construct in other theaters. JP 3-14 is now being evaluated for revision. It is essential that it be updated to reflect the current CENTCOM construct. The CENTCOM DIRSPACEFOR warfighting construct needs to be codified in joint doctrine—much more than an advisor to the COMAFFOR.

Another significant change has occurred in recent times—USSTRATCOM created a joint functional component command for space (JFCC SPACE) and the Joint Space Operations Center (JSpOC) at Vandenberg AFB, California. Until May of 2005, no individual or place existed where joint space effects could be integrated at the operational level of war from a global perspective. USSTRATCOM (and previously USSPACECOM) attempted to provide operational synchronization and integration from the strategic level and many times operational units attempted to integrate operational capabilities at the tactical level where possible—but a large void existed in our ability to command and control joint space forces. The 14th Air Force air and space operations center (AOC) attempted to fill this role in the early stages of Operations Enduring Freedom and Iraqi Freedom, but it had no joint standing to provide this function.

Once again, JP 3-14 confuses the issue in describing operational C2 when it describes the roles of the service components; Army, Navy, and Air Force. For the Air Force, it describes basically tactical responsibilities for the commander of Space Air Forces (SPACEAF). Specifically it states, the mission of the SPACEAF is to operate space forces for ballistic missile warning, navigation, communications, spacelift and space control, and to provide satellite operations capabilities.[7] For the most part, this is actually the responsibility of the operational wings.

JP 3-14 then describes the role of the AOC as follows: the SPACEAF commander will provide, plan, and exercise operational control (OPCON) of assigned forces as a component of the USSPACECOM. The SPACEAF commander exercises OPCON of assigned Air Force space forces through the SPACEAF AOC. The SPACEAF AOC is a standing AOC to support global space operations. When used for reachback, the SPACEAF AOC is the interface for the theater to gain access to Air Force space capabilities. It has the ability to expand during contingency support using augmentation.[8]

This inherently requires the theaters to establish some construct (not yet defined) for reaching back into the AOC for SPACEAFs and other constructs for Army, Navy, and national space capabilities.

USSTRATCOM addressed this problem by assigning operational authority for all joint space operations to the commander (CDR) JFCC SPACE. The CDR JFCC SPACE exercises his

authorities through the JSpOC. The JSpOC mission statement sums up its critical role as follows: "JFCC SPACE continuously coordinates, plans, integrates, commands and controls space operations to provide tailored, responsive, local and global effects, and on order, denies the enemy the same, in support of national, USSTRATCOM, and combatant commander objectives."[9]

For the first time, we have an effective, proper organizational construct for providing space capabilities to the joint fight. In CENTCOM, the CFACC is delegated SCA. He is supported by a DIRSPACEFOR and a joint team with the ability to reach effectively across the theater and reach back as well. They also have the ability to reach back to an operational commander, CDR JFCC SPACE, who, through a global JSpOC, reaches across the services and agencies to provide synchronized effects from global space capabilities directly to the fight.

As with any new organization, there have been and will continue to be growing pains. The ability to man, organize, train, and equip new organizations is a challenge in any environment, but even more so in a time of war and severe budget strains. Nonetheless, for the first time, we have the right organization, and it is essential that we codify this structure in a new JP 3-14 so we can begin to exercise and improve this process across the world. It needs to be accepted as authoritative throughout our entire military structure.

Other Challenges

Organization and doctrine are indeed critical in order for us to continue to improve the way we deliver space capabilities to those around the world who need them. However, they are not, by any means, the only challenges we face in the near future. The Air Force, and in many cases the nation itself, faces a number of significant challenges that must be addressed soon as we continue to evolve our command-and-control processes. If we fail to meet these challenges, we will, at a minimum, fail to take full advantage of the new capabilities coming online and potential improved capabilities that can be delivered from space. In the worst case, we may fail to complete a mission or missions that have significant consequences for American lives and treasure. The remainder of this article will *briefly* describe some of these other challenges.

Space is a contested environment. It will only become more of a challenge as time goes on. The Chinese anti-satellite test (ASAT) on 11 January 2007 acted as a wake up call for many in our nation who thought space would always be a sanctuary. It is clearly not to those of us in AFSPC.

It is, however, easy to focus on this singular event and react to this very visible threat. There are many other threats to our space systems that we must be concerned about—not only to our satellites, but to our ground and link infrastructure. The nation cannot afford to build systems into every satellite to protect them from every threat, but we cannot ignore the message the Chinese delivered more than a year ago. We need to learn from what happened. We must recognize the fact that we need better space situational awareness (SSA) and that SSA includes, but is much more than, space surveillance. We need to recognize the need for integrated intelligence, reconnaissance, and space environmental information that can be fused with surveillance data to paint an accurate picture of what is happening in space, and define whether there is a threat or not.

This is easy to say—hard to do—exacerbated by the decreasing budgets we face in the Air Force today. What we need to do is develop a coherent national strategy that leverages all our instruments of national power—economic, diplomatic, as well as military. We need to determine what specifically is required of the military instrument of power before we invest our limited resources in any particular area. What is clear is that we need investment in this area, certainly in the SSA mission area, but we also need to make sure that investment is properly made.

Space is a joint challenge. Although the bulk of uniformed space professionals wear the Air Force uniform and the vast majority of the funding for military space is in the Air Force budget line, space is not the sole purview of the Air Force. Other services and agencies have critical roles to play in bringing space capabilities to the fight. The vast majority of forces engaged in the global war on terrorism (GWOT) today are ground forces who need significant support from space. They must get space support through experts embedded with them on the ground who can reach back and gain space support using the process described previously. How to organize, train, and support the other services is a continuing challenge for the Air Force, particularly when budgets are getting tighter. In many cases, the Air Force ends up paying bills for requirements that are not Air Force requirements. This will continue to be a challenge.

Many have criticized the Air Force for not being good "stewards of space." This is not new criticism either. As reported by the Space Commission in 2001: "few witnesses … expressed confidence that the current Air Force organization is suited to the conduct of [the nation's new space missions]. Nor was there confidence that the Air Force will fully address the requirement to provide space capabilities to the other services."[10]

I do not believe these are valid criticisms or at least they fail to take into account the practical limitations facing our service. Although the secretary of the Air Force has been designated the DoD executive agent for space, no military department, including the Air Force, has ever been assigned the role of lead service or given the funding authority to support the unique joint requirements of space. Therefore, the Air Force has been given the task of balancing the requirements for space capabilities, with a limited budget, against the myriad of other Air Force requirements—the continuing GWOT, air superiority, long-range strike, intelligence, surveillance, reconnaissance, C2, and so forth. Given the significant budget pressures, I think, on balance, the Air Force has done an admirable job in acting as a good steward for space—recognizing that, with current budgets, the Air Force will never meet all the joint requirements that exist.

The Air Force has also reached out to other services in providing joint space training at the National Security Space Institute, funded by the Air Force, educating joint personnel on how best to apply space capabilities. It is important, however, that other services fund their service-unique requirements—particularly user equipment—and that the Air Force continue to step up and fund Air Force and joint space requirements, while balancing them with other Air Force requirements. Unless the Air Force is assigned as lead service for space and the space budget (Air Force

budget) is increased proportionately (unlikely in time of war), the DoD and critics elsewhere must understand that the Air Force will continue to act as good stewards of space, but will make decisions from time to time that negatively impact space to support other priorities. That is the nature of a service budget.

Space operations are a lot more than flying satellites and launching rockets. Space professionals in AFSPC have become experts in the business of satellite telemetry, tracking, and control and the business of launch operations. The recent record string of successful launches and the robust health of our operational constellations demonstrate this better than any words can describe. However, these should not be the sole focus of space operations. The real purpose of space operations is to provide assured space capabilities and deliver combat capabilities to the warfighters around the world. In order to provide capabilities and deliver effects, our space operators must develop a different set of core competencies than they have today.

The contested environment described previously presents the first challenge for our operators. They must develop the knowledge and skills necessary to understand the environment they operate in and the potential threats they may face. They must then develop the means to preserve and protect critical space capabilities and ensure space effects continue to be delivered to users around the world.

Air Force space operators must also develop the ability to effectively operate the taskable satellites that are coming online in the near future (e.g., space-based space surveillance, the space-based infrared system, and eventually a space radar). The ability to maintain situational awareness in the environment as well as user needs, and to adjust realtime, are skills that we have not trained for in the past. We must in the future.

It's really all about the network. In the near future, our satellite capabilities will begin to look much different than today, and our operations will begin to look much different as well. Rather than single stovepiped satellites providing localized effects on the ground, our satellites will transition into part of a network. They will be even more joint and interoperable than we can imagine today. Everything we do will be on or through the joint network, and so we need to think hard about how we are organized to operate that network.

Today, we have significant infrastructure built within the MILSATCOM world to allocate channels and transponders. That infrastructure must change considerably as channels and transponders are replaced with an internet protocol environment. It also will not make sense to continue to proliferate satellite dishes to command and task single satellites when we can access satellites from multiple methods through the network. This is a completely different way of doing business, and requires a great deal of thought to lay in the new infrastructure and make sure we do so in a cost-effective, efficient manner.

Conclusion

As I stated earlier, we are doing pretty darn well in bringing space capabilites to bear in support of the GWOT. Yet, we are likely to be in this fight for a long time, and the world we live in is changing rapidly. We face some significant challenges, and how we address them, will make a big difference in our success in this war. We need to document our current best practices in joint doctrine and then continue to evaluate and improve on the way we do business. We need to look at the future, understand how close it is, and make some significant changes in the way we organize, train, equip, and ultimately fight our space capabilities. We must prepare ourselves for operations in a contested environment. And perhaps our biggest challenge will be to continue to operate every day, while at the same time changing our methods of operations to meet the challenges of the future. That has always been the challenge of fighting and winning in space. The challenge just seems to get more complicated as the effects we provide make more and more of a difference on the battlefield and around the world.

Notes:

[1] Craig Covault, "Desert Storm Reinforces Military Space Directions," *Aviation Week and Space Technology*, 8 April 1991, 42.

[2] MSgt Kate Rust, AFSPC Public Affairs, 25 October 2007.

[3] WordNet® 3.0, © 2006 by Princeton University.

[4] Joint Publication (JP) 3-14, Joint Doctrine for Space Operations, 9 August 2002.

[5] Ibid.

[6] Air Force Doctrine Document 2, 3 April 2007, 36.

[7] JP 3-14, II-4.

[8] Ibid.

[9] Joint Functional Component Command Space Mission Brief, 21 August 2007, http://www.afcea.org/events/pastevents/documents/Track5Session2-LeveragingStrategicCapabilities.ppt.

[10] Report of the Commission to Assess US National Security Space Management and Organization, Washington, DC, 11 January 2001, 13.

Brig Gen John E. Hyten (BA, Engineering and Applied Sciences, Harvard University; MBA, Auburn University) is the director of Requirements, Headquarters Air Force Space Command (HQ AFSPC), Peterson AFB, Colorado. He is responsible for ensuring future space and missile systems meet the operational needs of our joint forces into the 21st century.

General Hyten was commissioned through the Air Force Reserve Officer Training Corps at Harvard University in 1981. His career includes assignments in a variety of space acquisition and operations positions. He has served in senior engineering positions on both Air Force and Army anti-satellite weapons system programs. His staff assignments include tours in the Air Force Secretariat, on the Air Staff, on the Joint Staff and as the director of the Commander's Action Group at HQ AFSPC. He served as a mission director in Cheyenne Mountain, and has commanded at the squadron, group and wing levels. In 2006, he deployed to Southwest Asia as director of space forces for Operations Enduring Freedom and Iraqi Freedom. Prior to assuming his current position, General Hyten commanded the 50th Space Wing at Schriever AFB, Colorado.

Joint Forces and Space:
Applying Joint Force Attributes for Success

Brig Gen James M. Kowalski
Deputy Director for Global Operations, Joint Staff
Pentagon, Washington DC

At the beginning of the global war on terrorism (GWOT), United States special forces waged a new kind of war. This new kind of war brought our technological advantage to bear on the enemy by a select few warriors assisting the Northern Alliance forces to defeat the Taliban regime in Afghanistan. Satellite communications equipment and laser range finders coupled with a GPS receiver, packed in a backpack with ammunition and other battle gear, allowed our Special Forces to direct the delivery of precision fire from Air Force, Navy, Marine, and coalition strike aircraft. As a result, the Taliban and their al-Qaeda allies quickly dissolved into the countryside where US, Afghan, and coalition forces continue to pursue them with the help of the battlespace awareness provided by space-based capabilities.

As the GWOT expanded beyond Afghanistan into Iraq our Soldiers, Sailors, Airmen, and Marines conducted their own version of asymmetric warfare—exploiting our technological advantage, especially our space superiority in air, land, and sea operations. Our space power both improved and dramatically changed the way we fight. I believe US space forces successfully produced the effects our joint forces need to deliver victory because the joint force adapted space capabilities to exhibit the attributes called for in the *National Military Strategy (NMS) for the United States of America* and the *National Military Strategic Plan for the War on Terrorism*. Our joint warfighters adapted space capabilities developed and deployed to counter Cold War adversaries to answer the terrorist threat. Still, a review of the Chairman of the Joint Chiefs of Staff (CJCS) priorities found in the *CJCS Guidance for 2007-2008,* highlights where we must focus to ensure the joint force can continue to deliver space effects on the battlefields of the future.

Of the four space mission areas; space control, force enhancement, space support, and force application, force enhancement delivers most of the direct effects to the warfighter. Space force enhancement functions include: intelligence, surveillance, and reconnaissance (ISR); missile warning; environmental monitoring; communications; and position, navigation, and timing.[1] All of these functions are available by other means, but our space capabilities have the advantage of being unfettered by geographical boundaries, providing persistent global access to space effects.[2] No matter where we deploy our joint forces, they enjoy the asymmetric advantage delivered by our space force enhancement capabilities. For the remainder of this discussion, therefore, we will focus on the space force enhancement mission area.

Special Operations Force with Northern Alliance.

National Military Strategy for the United States of America: A Strategy for Today, A Vision for Tomorrow

The *National Military Strategy for the United States of America* defines seven desired attributes for the joint forces:[3]

- ***Fully Integrated*** – functions and capabilities focused toward a unified purpose
- ***Expeditionary*** – rapidly deployable, employable, and sustainable throughout the global battlespace
- ***Networked*** – linked and synchronized in time and purpose
- ***Decentralized*** – integrated capabilities operating in a joint manner at lower echelons
- ***Adaptable*** – prepared to quickly respond with the appropriate capabilities mix
- ***Decision Superiority*** – better-informed decisions implemented faster than an adversary can react
- ***Lethality*** – destroy an adversary and/or his systems in all conditions

US space assets enable joint force to possess, all of these attributes. The position, navigation and timing services provided by the GPS are *fully integrated* into the joint force. Joint tactical air controllers derive target coordinates from a GPS receiver, which are then loaded as the targeting solution for any of a variety of GPS-aided weapons—Joint Direct Attack Munitions to the Army's Tactical Missile System—to guide the weapon to the target. Whether it is the infantrymen of the 101st Airborne Division in Baghdad fighting anti-Iraqi forces, F-15E Strike Eagles rendezvousing with a KC-135 tanker to refuel over the Indian Ocean, or a provincial re-

F-15E Strike Eagle.

construction team near Kandahar surveying the terrain in preparation for road construction, all use GPS as a part of day-to-day operations.

The global availability of space effects enables *expeditionary* operations. No matter where the joint force is directed to fight, the same space effects are available to serve the full spectrum of possible operations. While deployed, our joint force are *networked* through space communications, linking our forces throughout the region and the globe to ensure synchronicity and unity of purpose. These same space capabilities enable decentralized operations by allowing lower echelon commanders access to the information they need to make decisions that are in line with the joint commander's intent. Equally important, these same conditions can be appropriately integrated with other commands in a distributed battlespace.

Space capabilities are inherently *adaptable*, as evidenced by the ubiquitous integration of space capabilities into all military operations. Space force enhancement functions are a part of every military operation, and they are critical to sustaining our tactical and operational advantage.

Space-based ISR and communications enable *decision superiority* by providing the information and network required to make more accurate decisions faster than the enemy. Anticipating enemy courses of action through intelligence preparation of the battlespace, combined with the knowledge of enemy capabilites and disposition, gets US joint warfighters inside the enemy decision cycle. Real-time global communications allows commanders to implement their decisions immediately throughout their command.

Combined with GPS capabilities, decision superiority increases the *lethality* of the joint force by putting the right weapons on the right target, with precision, at the right time.

The joint force attributes were not part of the strategic calculus when the services designed and deployed most of our space systems, but our joint warfighting professionals' creativity and ingenuity applied the advantages of space-based systems in war-winning ways to change and dramatically increase our combat effectiveness. As US joint warfighters adapted space capabilities, they kept sight of the NMS's guiding principles of *agility, decisiveness, and integration*.[4] Global access with mobile user systems improves the joint force's agility to deploy, employ, sustain, and redeploy throughout the globe in any environment. Satellite communications, GPS services, and space-based ISR enable the massing of effects to overwhelm our adversaries and achieve decisive, definitive victories. The development of space applications and their design into capabilities throughout the joint force allows the US to achieve integrated operations.[5]

US military space capabilities are critical to retaining a lead in the strategic environment and achieving our military objectives. The strategic environment promises to provide a *wide range of potential adversaries,* a *more complex and distributed battlespace, and the diffusion and broader access to technology.*[6] US military space capabilities and the manner in which joint warfighters use them allow us to respond to the wider range of potential adversaries. For example, US missile warning capabilities allow the US to detect and respond to adversaries threatening the US homeland or deployed forces with tactical or intercontinental ballistic missiles. Global access to satellite communications allows the joint fight to tie together the complex, distributed battlespace and use it to our advantage.

Our current space advantage is shrinking as dual-use capabilities become available to our adversaries in the commercial market. Commercial imagery provides targeting information on US and coalition bases and facilities in the homeland and at deployed locations. Global communications are readily available to our adversaries, as are commercial GPS services that, ironically, the US military provides for free to whomever can purchase a receiver. Fortunately, our focused military application of our space capabilities continues to balance the risks from technological proliferation.

These space capabilities, and the effects they bring to the battlefield, are key to the joint force's ability to achieve three national military objectives. Space-based ISR and communications collect and share the intelligence data and information used to develop the indications and warning required to *protect the United States against external attacks and aggression.* The same indications and warning aid decision makers in using the other elements of national power to *prevent conflict and surprise attack.* When faced with a determined enemy that does not respond to the other elements of national power, space capabilities give the joint force the advantage of the high ground to *prevail against our adversaries*.[7] While we might be able to meet our military objectives without space capabilities, it would be significantly more challenging and costly.

National Military Strategic Plan for the War on Terrorism

The *National Military Strategic Plan for the War on Terrorism* defines two strategic aims: "defeat violent extremism as a threat to our way of life as a free and open society, and create

The global access to satellite communications allows us to tie together the complex, distributed battlespace and use it to our advantage.

When faced with a determined enemy that does not respond to the other elements of national power, space capabilities give the joint force the advantage of the high ground to prevail against our adversaries.

a global environment inhospitable to violent extremists and all who support them." To achieve these aims, US military strategy builds on three key elements:[8]

- Protect and defend the homeland
- Attack terrorists and their capacity to operate effectively at home and abroad
- Support mainstream efforts to reject violent extremism

Space capabilities contribute directly to the first two elements. Space capabilities aid in collection and sharing of information and intelligence that helps our leaders understand the complex, global strategic environment and the transnational, distributed, networked nature of the enemy. The global availability and flexibility of space capabilities contribute to the agility and adaptability of our forces tasked to attack the terrorists directly and indirectly, whether from the ground, the sea, or the air. Space capabilities support the denial of safe haven to the enemy, assist in confounding their movement, access to weapons, and their operations.[9]

Chairman of the Joint Chiefs of Staff Priorities

The CJCS publishes a guidance message to the Joint Staff on an as-needed basis. Upon assuming the Chairmanship, Adm M. G. Mullen issued a strategy to guide the joint force through the next two years in preparation for the future. The chairman's guidance includes three priorities:[10]

- Develop a strategy to defend our national interests in the Middle East
- Reset, reconstitute, and revitalize our armed forces
- Properly balance global strategic risk

US military space capabilities play an important role in any strategy for the Middle East. This is true not only in the current fights in Iraq and Afghanistan, but also as we consider other sources of instability in the region. Iran continues to challenge the world community through development of weapons of mass destruction technology and long-range missile systems. A resurgent al-Qaeda and associated movements threaten future attacks on America's homeland and our partners in the Middle East. The unique effects delivered by our space capabilities will be vital to responding to the wide range of current and future threats.

The effort to reset, reconstitute, and revitalize our armed forces will rightly focus on those ground, air, and sea forces most affected by deployments and combat over the past six and one-half years. What is difficult to see is the need to apply the same philosophy to our space forces. Here is one of our greatest challenges. Given budget constraints and the rightful emphasis on our ground forces, the revitalization of our space capabilities risks being marginalized or delayed. We must be clear in prioritizing our most critical space capabilities and be vigorous in seeking the support needed to sustain and evolve these capabilities.

The revitalization effort should apply lessons learned and meet a need for improved capabilities, while encouraging greater efficiencies in delivery capabilities and space operations.

In January 2007, China demonstrated the capability to destroy a satellite in low-Earth orbit. China's demonstration highlights the vulnerability of our space assets. Both our policy and technical development must adjust to the clear fact that space is not a sanctuary. Not only must we reconstitute our core space capabilities, we must revitalize strategies and capabilities to provide rapid recovery from the effects of attacks on our space systems.

This must be done under the lens of properly balanced strategic risk in an uncertain future. What is certain, however, is that our reliance on space effects will increase, and the value of those effects will continue to be critical to the way we fight, no matter the adversary.

Assured access to space effects gives US forces an asymmetric advantage on the ground, at sea, and in the air. The impres-

CH-46 Sea Knight in Afghanistan.

Tactical Satellite Communications, INMARSAT terminal and AN/PSC-5 Portable SATCOM Terminal.

sive effects produced by our space capabilities changed how we fight and created a dependency on space. We have to acknowledge this risk and take the measured steps to mitigate it.

Conclusion

The application of space power sharpened our spear and increased the precision, speed, and lethality with which we may strike our enemies. Global, geographically unfettered access to space effects enables the full integration of an expeditionary joint force that is networked, decentralized, adaptable, and able to act with the decision superiority and lethality required to ensure military victory. That victory will be defined by successfully *defending the United States, preventing conflict and surprise attack, and prevailing against our adversaries*. To prevail in the GWOT, we must prevent attacks on our homeland and bring the fight to the enemy by attacking them wherever, whenever, and however they expose themselves. Space capabilities are a large part of that fight, providing war-winning advantages for the joint force. Our joint warfighters responded superbly to the need for change by adapting space capabilities to the needs of the GWOT. We must remain agile, and within the context of appropriately balanced strategic risk, sustain and revitalize our space capabilities. Failure to sustain our space advantage will have dire consequences across the spectrum of conflict, and could embolden potential adversaries. During World War II, we learned the value of air superiority as a prerequisite for victory on the ground. Today, we need to commit to assuring our access to space as a prerequisite for victory on the ground, at sea, and in the air.

Assured access to space effects gives US forces an asymmetric advantage on the ground, at sea, and in the air. The impressive effects produced by our space capabilities changed how we fight and created a dependency on space.

Notes:

[1] Joint Publication 3-14, Joint Doctrine for Space Operations, The Joint Staff, 9 August 2002, http://www.dtic.mil/doctrine/jel/new_pubs/jp3_14.pdf, vii – x.

[2] Joint Publication 3-14, I-1 – I-3.

[3] *National Military Strategy of the United States of America: A Strategy for Today; A Vision for Tomorrow,* The Joint Chiefs of Staff, 2004, http://www.defenselink.mil/news/Mar2005/d20050318nms.pdf), 15-16.

[4] *National Military Strategy,* 7-8.

[5] Ibid.

[6] Ibid., 4-6.

[7] Ibid., 2-3.

[8] *National Military Strategic Plan for the War on Terrorism,* Chairman of the Joint Chiefs of Staff, 1 February 2006, http://www.defenselink.mil/qdr/docs/2006-02-08-Strategic-Plan.pdf, 19-20.

[9] Ibid., 14-18.

[10] CJCS Guidance for 2007-2008, Admiral M. G. Mullen, 1 October 2007, http://www.jcs.mil/CJCS_GUIDANCE.pdf, 3-5.

Brig Gen James M. Kowalski (BA, Business Administration, University of Cincinnati; MA, Central Michigan University, Mount Pleasant; MA, National Security and Strategic Studies, Naval War College, Newport, Rhode Island) is deputy director for Global Operations, Operations Directorate, the Joint Staff, Washington, DC. He is responsible to the chairman of the Joint Chiefs of Staff for oversight and coordination of worldwide operational matters including joint force readiness; strategic and reconnaissance operations; command system operations; information operations; space and missile defense; psychological operations; special technical operations; and management of the National Military Command System.

General Kowalski was commissioned in 1979 through the ROTC program at the University of Cincinnati. He has held a variety of operational commands, including a bomb squadron, an operations group, a bomb wing and an air control wing. His contingency and wartime experience includes command of the 2nd Operations Group when they deployed B-52s for combat during operations Noble Anvil and Allied Force, and command of the 28th Bomb Wing when they deployed B-1s for Operation Iraqi Freedom. From January 2003 to May 2003 General Kowalski commanded the 405th Air Expeditionary Wing in Southwest Asia where he led a combined wing of B-1s, E-3s and KC-135s to provide strike, battle management and air refueling for Operations Iraqi Freedom, Enduring Freedom, and Southern Watch. His previous staff assignments include Headquarters Air Combat Command, Headquarters Air Force and the Joint Chiefs of Staff.

General Kowalski's military education includes the Secretary of Defense Fellows Program, Air Force Institute of Technology, Urbana, Illinois; Joint Aerospace Operations Senior Staff Course, Hurlburt Field, Florida; Senior Leader Course, Center for Creative Leadership, San Diego, California; Combined Force Air Component Commander Course, Maxwell AFB, Alabama.

Preparing for Conflict in Space:
A New Perspective of the Joint Fight

Ms. Lorraine M. Martin
Vice President, Flight Solutions
Lockheed Martin Simulation, Training and Support
Orlando, Florida

Space as a Warfighting Medium

There are moments that change the world, and so it was with the launch of Sputnik in October 1957.

Even as that first primitive satellite arced across the sky, the Earth it orbited was forever transformed. In an instant, a world that had been land, sea, and air was now bound to a fourth realm—space.

As we reflect on the evolution of the role of space in the 50 years since Sputnik stunned the world, we must recognize how completely activities in space have become integrated with those of land, sea, and air.

The benefits of space capabilities in support of military, diplomatic, intelligence, and commercial activities have been profound. New benefits continue to be derived from space applications, many of these spin-offs of systems originally developed to support our nation's military and other government agencies.

Communication, command and control (C2), warning, targeting, reconnaissance, the ability to transfer massive quantities of information—all are examples of activities not only furthered by the technologies garnered from space operations, but enabled by the integration of those space capabilities with the mediums of land, sea, and air.

Militarily, there has been a shift from the solely strategic focus of Sputnik's day, such that space capabilities now have become a critical enabler of today's joint warfighter. Indeed, the importance of space as a warfighting medium has evolved until it is now on "equal footing with air, land, and sea."[1]

The pivotal role space plays in a vast spectrum of activities was appropriately documented in the August 2006 National Space Policy:

> In this new century, those who effectively utilize space will enjoy added prosperity and security and will hold a substantial advantage over those who do not. Freedom of action in space is as important to the United States as air power and sea power. In order to increase knowledge, discovery, economic prosperity, and to enhance the national security, the United States must have robust, effective, and efficient space capabilities.[2]

Operations in Space will be Challenged

As space capabilities have expanded in the years since Sputnik's launch, so too have the abilities and incentives of adversaries to target those assets. No longer is it true that "satellite operations take place in a benign environment, devoid of any threat except the space environment."[3] The fact that US space operations for decades enjoyed a largely uncontested level of superiority may have lulled perceptions to expect the same uncontested environment in the future. Unfortunately, this is not to be the case. In 2001, a Congressionally directed Commission to Assess United States National Security, Space Organization and Management summarized what the future will likely hold for critical space operations:

> We know from history that every medium—air, land and sea—has seen conflict. Reality indicates that space will be no different. Given this virtual certainty, the US must develop the means both to deter and to defend against hostile acts in and from space.[4]

A review of recent events indicates that the Space Commission's assessment is, in fact, becoming a reality. Numerous unclassified accounts document how space operations are being challenged today, and demonstrate how adversaries may attempt to deny the use of space in the future. Table 1 provides a summary of events that serve as warning signs and provide some insight into how we can expect future operations in space to be contested.

Date	Event
March 1999	Hackers attack UK satellite[5]
July 2003	Voice of America broadcasts to Iran jammed[6]
March 2003	Iraq jams GPS signals during Operation Iraqi Freedom[7]
September 2006	China attempted to blind US satellites with laser[8]
Extended periods in 2006	Libya jams mobile satellite communications[9]
January 2007	Chinese missile destroys satellite in space[10]

Table 1. Some Recent Actions Against Space Systems.

A New Joint Fight – Protecting Space

An important aspect of space as it relates to the "joint fight" involves the way we plan and train for the day when space operations will come under attack. While some envision a space engagement as a battle waged from within the closed rooms of satellite operations centers, the reality is that this fight will demand a high level of joint and interagency coordination.

For example, when Iraqi forces jammed GPS signals during Operation Iraqi Freedom, the US response was a coordinated targeting process to bomb jamming locations in the combat zone. In the case of foreign jamming of satellite signals or broadcasts, the response could require coordination with the State Department. And whether the appropriate response to a threat is diplomatic or military, close coordination with the intelligence community will be required to help characterize and assess indications of a space attack. Whether the aim is to create a credible space deterrent through actions to preempt or

suppress attacking forces, or to restore space-based capabilities, the use of carefully coordinated joint actions will provide a key element to the successful space protection campaign.

Given that we can expect space operations to be challenged and that a credible response will require a coordinated joint effort, it is only logical that we would want to prepare for this eventuality now. The obvious defense is to ensure space operations are afforded a level of protection that is commensurate to the impact that would be incurred should they come under attack. Or, to put this another way, consider Edward N. Luttwak's work on strategy, which touches on the Latin phrase *Si vis pacem, para bellum* (If you want peace, prepare war.).[11] Preparation for war is a means to dissuade attack that weakness would invite.

In order for a space protection strategy to be effective, a joint, interagency approach must be trained and understood so that it can be executed in a timely fashion. The need for providing a timely response to a space attack cannot be over emphasized. Any delay during the opening moves of a space battle will result in further losses and serious consequences to joint warfighting forces. Low-Earth satellites orbit the earth every two to four hours. Many satellites will be vulnerable to attack from a single ground site within a 12- to 24-hour period. Any delay in responding to attack could mean losing an opportunity to protect critical space assets. This requires that all participants understand their roles and stand prepared to respond immediately.

Training for the joint space battle poses interesting challenges, as it is not feasible to adequately train using operational space platforms. Preparation for a space battle requires operators, users and decision makers to be exposed to the indications of an actual attack. But using operational systems to support the training of actual threat conditions would place these critical assets at unacceptable levels of risk. The only realistic method for conducting this type of training involves the use of a synthetic battlespace where the events of a space battle can play out in a realistic fashion.

Today, synthetic battlespace technology already is in use to train and prepare warfighters for complex interagency missions. This technology has proven invaluable when platforms such as aircraft or convoy vehicles are unavailable due to high demand or when cost constraints restrict their operation in a training environment. The challenge is to extend these proven training techniques to space and the integrated, joint mission of space protection.

Joint training is critical because the mission of space protection must be conducted jointly with land, sea, and air assets. Consider the manner in which a space attack might unfold, and the complex steps in developing an appropriate response. Users of satellite data might be the first to receive indication of attack when the data they are using is denied. These users could be land, sea, and/or air assets, depending upon the nature and extent of the attack. Or perhaps satellite operators, or a variety of space sensors, will first detect indications of an attack. Either scenario could require tasking additional sensors to collect information needed to accurately characterize space events.

A key challenge will be fusion of data from numerous sources to provide a precise diagnosis of the attack while ruling out the possibility of satellite malfunction or impact from the space environment. Assessment of the nature of a space event is critical and demands the highest level of confidence: There is no room for mistakes when the response to space attack could pose significant repercussions. After the assessment is accomplished, the decision-making process for providing an appropriate response also will be challenging, and may be complicated by the attack itself. For example, while responding to a space attack, military forces may be required to rely temporarily on alternate sources for navigation, communication or weather forecasting. Operating in those circumstances will demand a higher level of coordination between all joint forces.

Recommended Approach

Given the fact that potential adversaries are developing and demonstrating the ability to challenge our space capabilities, it is increasingly important that we are prepared to provide a coordinated joint response in the case of a space attack. The nature of the space medium requires joint space protection training be conducted with the use of a simulated environment. This simulated battlespace would support training for all joint space forces along with key decision makers and interagency participants. While progress has been made in the area of space war games and exercises, there is still significant work to be done, as is highlighted in a recent article entitled "The First Line of Defense" by Brig Gen John Hyten, previous commander, 50th Space Wing.

> In the face of an active threat, the operator must be able to quickly detect, analyze, and fight through an attack on his/her satellite ensuring the continued delivery of critical space effects to combat forces (and civil users) around the world. Through no fault of their own, this is not the case today. Unfortunately, our current organization, equipment, C2 structure, and training do not allow this type of response."[12]

The recommended approach for providing an appropriate simulated space protection training environment is to build on many of the capabilities that are currently available. By taking this approach, the time and resource investment is minimized while providing an improved training capability in the minimum amount of time. The focus of this effort needs to be on delivering key simulation capabilities that allow the following activities to be realized:

- Delivering a realistic and unconstrained environment where Space Aggressor Squadrons can fully emulate hostile space tactics.
- Exposing all space operators and decision makers to actual threat indications in a way that could never be done with operational space platforms.
- Developing and refining response tactics, techniques and procedures as they apply to every level of space protection strategy.
- Reducing response times as operators become familiar with potential threat indicators.
- Facilitating operational and strategic level response options that capitalize on all needed joint force capabilities

along with elements of national power. Training must emphasize the interconnected nature of these decisions.
- Identifying and mitigating limitations in our ability to respond. This effort can lead to further material and nonmaterial solution development.

Given these initial building blocks, the end result that should be pursued is delivery of a simulation capability that can support the routine and frequent training of all Department of Defense space operators as well as the joint forces which will be called upon to defend an attack. Given the degree to which space, land, sea, and air capabilities are integrated, it is imperative that this training be conceived and conducted in a thoroughly joint manner to include all forces that will be required for a full-spectrum national response to a space attack. This approach brings the benefits of improving overall readiness through increased experience and proficiency. An improved space situational awareness would be realized with reduced uncertainty during the onset of an actual space attack. Space protection strategy and procedures also would mature at an accelerated rate as a result of validation within a representative battlespace environment.

Conclusion

This article described the need for a joint approach in formulating a plan for defending space assets from attack. As with any joint operation, proper planning and training are critical to success. The recommended approach involves building, from existing capabilities, a simulated battlespace that can support the training of joint space operators and decision makers. This training environment would further the development, training and refinement of response tactics, techniques, and procedures. Expected benefits from this approach are based on results achieved through the use of simulation to train for operations in the land, sea, and air mediums. Recent events highlight the compelling need to prepare for growing threats to joint forces that rely upon space as a critical enabler.

The importance of space to the interests of this nation scarcely requires elaboration. But one point cannot be overstated: Fifty years ago, Sputnik changed the world. The fact that it was the work of this nation's strategic adversary drove Americans to master the technology of space by establishing a superiority rarely challenged in the past half century. Today, new threats are emerging, with implications not only for our space operations, but also for the land, sea, and air capabilities to which they are inextricably linked. Defending America's superiority in space requires a commitment to prepare now for the challenges ahead.

Notes:

[1] General Lance W. Lord, Air Force Space Command, Commander's Call, 17 February 2006.

[2] US National Space Policy, 31 August 2006.

[3] Col John Hyten, "The First Line of Defense," *High Frontier* 2, no. 3 (April 2006): 28-32.

[4] Report of the Commission to assess United States National Security Space Management and Organization, 11 January 2001.

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[8] Vago Muradian, "China Attempted to Blind US Satellites with Laser," *DefenseNews.com*, http://www.defensenews.com/story.php?F=2121111&C=america (accessed on 15 January 2008).

[9] Peter de Selding, "Libya Pinpointed as Source of Months-Long Jamming in 2006," *Space News*, 9 April 2007, http://www.space.com/spacenews/businessmonday_070409.html.

[10] Associated Press, "Chinese Missile Destroys Satellite in Space," *Military.com*, 19 January 2007, www.military.com/NewsContent/0,13319,122410,00.html?ESRC=eb.nl (accessed on 15 January 2008).

[11] Edward N. Luttwak, *Strategy: The Logic of War and Peace* (Harvard University, Boston, MA: Belknap Press, 2002), 3.

[12] Air Force Doctrine Document 2-1.1 Counterspace Operations (2004), 25-28.

Ms. Lorraine M. Martin (BA, Computational Mathematics, DePauw University, Indiana; MS, Computer Science, Boston University, Massachusetts) is currently the vice president of Flight Solutions, Lockheed Martin Simulation, Training & Support, which includes aircrew training for the United States Air Force Special Operations Command, C130 aircrew training, F16, F22 and F15 pilot training, flight simulation systems for the US Navy and Marine Corps, and the F35 training system. In this current assignment, she is responsible for flight and space training for customers worldwide.

Ms. Martin joined Lockheed Martin in 1988 after serving as a US Air Force officer. With the company, she initially worked as program manager for computer security contracts in support of the Strategic Defense Initiative and the F-23 program. In 1996, Ms. Martin was named director, advanced information systems, and in 1998, was appointed director of command and control (C2) technology programs. She was next promoted to vice president of aerospace information operations, supporting the US Air Force, Navy, and Unified Command C2 programs. In 2003, Martin was named vice president and deputy of joint command, control, and communications systems at Lockheed Martin Integrated Systems & Solutions in Colorado Springs, Colorado.

Ms. Martin is a Lockheed Martin certified program manager and is the executive council chair emeritus for The Network Centric Operations Industry Consortium.

People Who Impact Warfare with Space Capabilities

Col John W. Raymond
Commander, 21st Space Wing
Peterson AFB, Colorado

Maj Troy L. Endicott
Commander's Action Group
Headquarters Air Force Space Command
Peterson AFB, Colorado

"Space Forces are inextricably embedded in combat operations." ~ General C. Robert Kehler, commander, AFSPC

Space-experienced Airmen, joint space forces, and the systems they operate, maintain, and secure deliver capabilities and effects to joint users all over the globe every second of every day. Space capabilities are part of the operational mainstream of a modern battlefield. They garner unprecedented successes across the spectrum of conflict from peace to crisis to war. From the late 20th century to the present, space capabilities are impacting modern warfare and allow joint forces to fight with enhanced awareness of the battlespace and to deliver swift, precise, and decisive combat effects with minimal collateral damage. Although military space operations are global in nature, successful employment for geographic combatant commanders requires the right people who can work theater synchronization and integration, space coordination, and streamlined reach back to global space command and control centers.

People Behind Space Synchronization and Integration—Past and Present

For over 50 years, the United States Air Force has staked a claim in providing dominant space and missile capabilities for joint operations. The Soviet Union's launch of Sputnik on 4 October 1957 was a wake-up call to Americans and changed their perception of modern threats. That event spawned breakthroughs and innovations as two Cold War competitors waged a rivalry from Earth's highest frontier. After the Sputnik launch, General Bernard A. Schriever and his "schoolhouse gang" subsequently built up the nation's first ICBM forces and set their sights on the stars. In a *Time Magazine* interview in 1957, General Schriever said, "The ballistic missile program has established the resources to move into space—[humankind] will keep pushing at the frontiers."[1] Knowing this, he led the development of the nation's first reconnaissance satellites and missile warning platforms. Less than 10 years later, follow-on space pioneers would build early satellite communications constellations, and in less than 20 years place experimental GPS into orbit.[2] The nation's space systems held the strategic high ground for the remainder of the Cold War.

Although one could make a strong argument that the Cold War was actually the original space war, several brief conventional contingencies during that period provided a look into how space systems could be brought to bear in a theater of war. It was not until the 1991 Persian Gulf War that joint forces started to truly understand the importance and utility of space systems to influence combat operations, whether used for precise navigation across a featureless terrain, theater ballistic missile warning, weather services, intelligence, surveillance, and reconnaissance (ISR), and satellite communications. This led then Air Force Chief of Staff (CSAF), General Merrill A. McPeak, and other senior leaders to dub Operation Desert Storm as the first "space war" and imprinted space in the operational warfighter's lexicon. General Ronald R. Fogleman, who followed McPeak as the CSAF, recalls with amazement the first time he realized space capabilities could allow him to see in near-real-time which Iraqi radars were active during the Gulf War from displays in his own combined air operations center (CAOC), located in South Korea. He said, "I believe that all our operational commanders became much more cognizant of how space assets enhanced the employment of forces on Earth."[3] (Even today, retired General Fogleman consults active-duty Air Force leaders as a senior mentor for the *Schriever*-series of space war games.) General Charles Horner, the combined forces air component commander (CFACC) during Operation Desert Storm, recognized the importance of space capabilities outside of a "green-door" Cold War environment and brought that first-hand awareness to AFSPC as its commander in 1992.[4]

Armed with a new sense of purpose, AFSPC leaders after the Gulf War heightened the Air Force's focus on direct space support to theater operations. Toward that end, the Air Force activated the Space Warfare Center in 1993 and the 76th Space Operations Squadron in 1995 to focus on space integration to theater and exploit space capabilities for joint operations.[5] By the time the United States fought an air war over the Balkans in the late 1990s, space systems were exploited for tactical effects that allowed rapid rescue of downed pilots, precise strikes, increased intelligence and better data dissemination to airborne aircrews, assured theater ballistic missile warning, and global broadcasts to pump previously unimagined amounts of data to and from warfighters. First-generation RQ-1 Predator reconnaissance unmanned aerial systems used satellite communications for over-the-horizon command and control. Space-experienced Airmen who started to populate the North Atlantic Treaty Organization (NATO) CAOC at the time in Vicenza, Italy, aided the education and integration of space capabilities into combat operations.[6]

Integration of space capabilities continued after the conflict

in the Balkans by joint space operators assigned to support Operations Southern and Northern Watch over Iraq. Space personnel integrated and synchronized space capabilities into combat operations and normalized procedures with land, air, and maritime components. These early theater space leads ranged from company grade to mid-level field grade officers in rank and were often hand-picked liaisons sent from US Space Command, AFSPC, or assigned space weapons officers who were early graduates from the Air Force Weapons School. These space-smart leaders commonly deployed to theater CAOCs and interfaced with reach-back organizations that were predecessors to today's Joint Space Operations Center (JSpOC) to define and refine combat roles, responsibilities, command and control relationships, and establish collaborative tools to link global and theater space organizations. During the years between the Balkans conflict and 11 September 2001, young space experts built up space cells in CAOC combat operations divisions (CODs) in multiple AORs to develop, refine, and exercise theater missile defense warning and reporting architectures; assist GPS-aided munitions strike planning; integrate space-based blue force tracker (BFT) systems into operations; and devise a national support to personnel recovery (PR) and combat search and rescue (CSAR) concept of operations. They also instituted innovative ways to use overhead non-imaging (ONIR) platforms to increase situational awareness for joint forces.

By the time Operations Enduring Freedom and Iraqi Freedom started, coalition forces benefited from a solid foundation poured from a decade of theater space integration and synchronization. From the outset of operations in Afghanistan and Iraq, AFSPC sent to theaters senior space officers—precursors to the directors of space forces (DIRSPACEFORs) found today supporting theater exercises and operations all over the globe. For the first time, colonels and newly-minted flag officers filled top positions in air component staffs to advise commanders of Air Force Forces (COMAFFORs)/CFACCs on the proper employment of space and had the requisite muscle to build and normalize relationships with global space centers. They and other embedded space operators and planners in CAOCs continued to normalize space capabilities into theater combat operations. Being close to the fight, they provided reach-back organizations the situational awareness of the overall strategy, schemes of maneuver, timing, and tempo of theater combat forces and ensured space support was tailored accordantly.

Figure 1. Coalition service members execute air and space operations at the combined air operations center during Operation Southern Watch.

As a result of years of space integration and synchronization, today space capabilities and people are embedded into combat operations like never before and buttress an Air Force pillar enabling global vigilance, reach, and power. GPS enhances an ever-growing arsenal of precise systems from bombs and artillery rounds to logistics bundles.[7] Theater ballistic missile warning and ONIR battlespace characterization are staple missions in combat zones. Satellite communications are the backbone of net-centric operations and link warfighters all over the globe, even enabling aircrews to operate today's armed unmanned aerial systems like the MQ-1 Predator and MQ-9 Reaper over the US Central Command (CENTCOM) area of responsibility (AOR) from the other side of the planet at Creech AFB, Nevada. Acknowledging a need to guard critical communications, the hugely successful Silent Sentry defensive space control system and its crews deployed to the CENTCOM AOR protect important links by detecting, characterizing, and geolocating interference throughout the theater.[8] Furthermore, space capabilities facilitate swift and effective CSAR/PR procedures and energize BFT architectures.

Mother Necessity Wears Combat Boots—A US Central Command Model

The magic behind modern space capabilities are the joint space professionals all over the globe who orchestrate them for decisive combat effects. Trained personnel with warrior-focused skill sets are especially critical and useful when placed forward in a theater of operations. In the ancient book, *Art of War,* Sun Tzu challenged military leaders to become "fit" by being "familiar with the face of a country." Even in a technology-enabled, 21st century force, proximity breeds familiarity. Because of the importance of space capabilities in operations, joint space professionals are now located throughout a theater of war in key warfighting echelons. They may come from a pool of the more than 80-trained DIRSPACEFORs to date, hundreds of theater-trained Air Force space officers and NCOs, or from an ever-increasing number of skilled Army experts who comprise space support teams and elements (SST and SSEs). Additionally, Navy space planners are assigned to carrier strike groups (CSGs), and space-savvy Marines are often found within Marine expeditionary forces (MEFs).[9]

A high concentration of space experts resides in the CENTCOM CAOC. In addition to a DIRSPACEFOR staff, space experts inhabit CAOC strategy, combat plans, combat operations, and ISR divisions to develop theater-wide air and space strategies, integrate space into master air attack plans, air-tasking orders, and assist with execution and effects assessment. Further forward in the CENTCOM AOR, space planners are integrated into the Multi-National Force-Iraq air component coordination element (ACCE) and Multi-National Corps - Iraq Army

space support team, NATO's International Security Assistance Force (ISAF) in Afghanistan, the Arabian Peninsula combined/joint special operations task force (CJSOTF-AP), and are part of space support elements organic to multi-national forces/divisions (MNF/Ds) and combined/joint task forces (CJTFs) throughout the AOR. Of particular note is the joint space support team attached to the MEF in western Iraq. This small, but highly effective team consists of Army, Air Force, and Marine space experts. Each space member brings a unique perspective and skill set to the MEF to maximize the integration of space capabilities to support decisive combat operations. These and all other space experts in theater understand the specific needs and requirements of their combat organizations and the operating environments in which they are fighting, and can best plan and tailor space capabilities for decisive effects.

Effective Space Coordination—Space Coordinating Authority and the DIRSPACEFOR

Because of their global nature, most space capabilities have to be deconflicted and coordinated appropriately amongst various space organizations to meet specific national and joint force requirements. Establishing a space coordinating authority (SCA) helps consolidate these efforts. Per Joint Publication 1:

> Coordinating authority is the authority delegated to a commander or individual for coordinating specific functions and activities involving forces of two or more military departments, two or more joint force components, or two or more forces of the same Service (e.g., joint security coordinator exercises coordinating authority for joint security area operations among the component commanders). Coordinating authority may be granted and modified through a memorandum of agreement to provide unity of command and unity of effort for operations involving reserve and active component forces engaged in interagency activities. The commander or individual has the authority to require consultation between the agencies involved but does not have the authority to compel agreement.[10]

A joint force commander (JFC) typically assigns the roles of space coordination to a single authority based on mission, nature and duration of an operation, preponderance of space force capabilities, and C2 means to include reach back.[11] It is the Air Force's view that the JFC should normally designate the COMAFFOR/CFACC with SCA responsibilities.[12] The first time SCA was designated to a component was during the outset of Operation Iraqi Freedom and was placed in the hands of the CENTCOM COMAFFOR/CFACC to facilitate unity of space efforts within theater.

Figure 2. Army and Air Force space officers in Baghdad, Iraq.

The concept of SCA works since no service or organization owns all-things space and many space systems transcend geographic AORs. Passing SCA to the air component also makes sense for major joint operations. The Air Force has a preponderance of space capabilities and forces trained and ready to execute a space mission, and the CFACC is able to leverage those capabilities through an inherent C2 construct and with embedded space expertise found in a theater CAOC. Furthermore, integrating air and space is in the CFACC's job jar if designated SCA. The CFACC leads the joint air estimate process that culminates with the production of the joint air and space operations plan to accomplish missions assigned by the JFC.

Today's CFACCs are increasingly space savvy and can more effectively conduct a space-coordinating role. Nevertheless, because of their heavy workload they often require a skilled space officer to execute that day-to-day authority on their behalf. To improve the CFACC's ability to integrate space capabilities, AFSPC has trained, allocated, and assigned to each geographic combatant command's component numbered air force (NAF) a permanent party DIRSPACEFOR. These DIRSPACEFORs deploy in support of the COMAFFOR and collaborate with other theater space experts to advise the CFACC on space employment; recommend appropriate space C2 relationships; integrate and normalize space processes in a CAOC; monitor the status of theater space forces; and provide a senior space perspective for strategy and daily guidance development, effects and target selection, and space integration throughout joint force operations.[13] While these stated tasks are extracted from Air Force doctrine, perhaps the role of the DIRSPACEFOR can best be summarized as the *go-to officer* for all things space. If the COMAFFOR becomes the CFACC with designated SCA, as is the case in CENTCOM, then the DIRSPACEFOR would likely be tasked to execute the joint SCA duties on behalf of the CFACC. This often translates to normalizing space into theater operations, connecting joint space forces and offering them a streamlined construct for theater space support, and providing the CFACC situational awareness of the space domain.

A small staff often assists the DIRSPACEFOR with space coordination duties. Realizing that the DIRSPACEFOR position is part of the COMAFFOR/CFACC special staff, it behooves a DIRSPACEFOR to minimize the size of his or her own team and leverage the expertise of space personnel embedded in the five CAOC divisions, the JFC staff, the COMAFFOR staff, and other component staffs. The DIRSPACEFOR position is not the genesis of a separate space division in the CAOC. On the contrary, its focus is to facilitate integration, not separation, of space capabilities into normalized theater processes. For example, the Central Air Forces (CENTAF) DIRSPACEFOR at the CENTCOM CAOC has a staff of six to assist in space coordination duties. On the staff is an Army

space operations officer as the deputy DIRSPACEFOR. The CENTAF Air Force DIRSPACEFOR has teamed with a highly skilled Army deputy since 2004, and the relationship has paid great dividends in coordinating space capabilities for theater forces in a predominately land-based fight. Also on the staff are experienced space officers who support Iraq, Afghanistan/Horn of Africa, and space control efforts. The goal of this team is to take on the 'heavy lifting' of receiving new requests for a variety of space effects, solving problems, and coordinating space capabilities for forces throughout the AOR. If applicable, they work to establish long-term space support processes and integrate those processes into the normalized cycle of the CAOC as they hand-off solutions to embedded space experts in CAOC divisions.

An example of space integration by the DIRSPACEFOR staff occurred in the fall of 2006 when the CENTCOM CFACC wanted to enhance the precision of the Air Force's new 250 lb. class, small diameter bomb (SDB) GPS-aided precision munition. His plan was to integrate the Talon NAMATH system developed by AFSPC's Space Innovation and Development Center's Tactical Exploitation of National Capabilities (TENCAP) team into theater operations. Talon NAMATH showed promise in its utility by delivering GPS corrections directly from the 2nd Space Operations Squadron (the unit responsible for operating the GPS constellation) where zero-age of data, differential GPS correction messages are automatically generated several times an hour. These messages are typically queued for transmissions to provide routine corrections to GPS satellites when they travel within view of uplink sites around the globe. Because of satellite orbitology, these messages can be queued for hours. Talon NAMATH takes advantage of these automated messages and when generated sends them directly to tactical link transmission sites in Iraq and Afghanistan where airborne link and SDB-enabled aircraft directly apply the corrections to deliver even more enhanced accuracy to an already remarkably precise GPS-aided weapons system. The CENTAF DIRSPACEFOR staff worked the effort to integrate Talon NAMATH into air operations and led a theater team that included SIDC and JSpOC personnel, F-15E aircrews, CAOC joint interface control officers, and CAOC COD space experts. Once the system went live in theater, it was normalized into CAOC operations and did not require further assistance by the DIRSPACEFOR staff.

Each situation requiring DIRSPACEFOR attention is unique. For example, when the new Silent Sentry SATCOM protection system arrived in the CENTCOM AOR, an action officer on the DIRSPACEFOR staff worked to generate tasking and prioritization processes and handed them off to the strategy, combat plans, and combat operations divisions for normalization into the CAOC's battle rhythm from planning to execution. Now Silent Sentry is routinely tasked through the air tasking order. Upon direction of the chief of combat operations, the CAOC COD space cell monitors the execution of the tasking and directs real-time changes in the SATCOM monitoring scheme if necessary.

These two examples show the value of the DIRSPACEFOR staff to energize space integration that leads to normalized processes within existing C2 structures. If the DIRSPACEFOR staff is working space strategy, planning, or execution outside of the CAOC architecture for extended periods, the staff should ask itself why and figure out how to transition those activities into CAOC processes. On the other hand, the DIRSPACEFOR should constantly refine ways to receive requests for space capabilities and further empower the CFACC in integrating them when and where needed in theater. To accomplish this in CENTCOM, the CENTAF DIRSPACEFOR staff instituted a process at the beginning of 2005 to capture, document, and ensure timely responses to component requests for space capabilities. Similar to the concept of air support requests, CENTCOM CAOC space personnel devised a space support request (SSR) process for joint space warfighters throughout the AOR to call for tailored space effects that support their unique requirements and operations. This process starts with theater space forces submitting an SSR to the CAOC CODs space cell or DIRSPACEFOR. The DIRSPACEFOR reviews the request, validates it, recommends prioritization to the CFACC, and determines means for providing the requested effects.[14] Some SSRs can be serviced using theater capabilities and processes while others require reach back to global space organizations.[15]

Figure 3. Deployed space graduates from the USAF Weapons School work together to optimize employment of the Air Force's small diameter bomb, GPS-aided precision munition.

For those requests that can be supported with theater space capabilities and assets, the DIRSPACEFOR and staff work to ensure solutions within theater. When applicable, the CFACC will task theater assets via the air tasking order with the COD space cell providing real-time monitoring of the execution.

For those space support requests that theater assets cannot fully provide a solution, the DIRSPACEFOR will reach back to the global space community to obtain the necessary support. Usually the DIRSPACEFOR will submit those SSRs requiring global capabilities and solutions to the JSpOC for processing. Planners in the JSpOC then review the requests, review their capability to support, and recommend overall global space capability prioritization to the commander, joint functional component command for space (JFCC-Space). The commander, JFCC-Space, will then build a strategy, plan, and task the nec-

essary global space assets via the space tasking order (STO) to provide the capabilities and effects needed when and where by theater forces.

A vignette that illustrates this process took place in the CENTCOM theater when the USS Eisenhower CSG transited the Strait of Hormuz to operate in the Arabian Gulf. Prior to the transit, the Navy space officer assigned to the CSG submitted SSRs to the CENTAF DIRSPACEFOR for detailed weather mosaics of the region, enhanced theater missile warning coverage, and increased vigilance and protection of satellite communications. The DIRSPACEFOR reviewed and validated the three requests and determined a mixture of theater and global capabilities were needed to provide the CSG's requested effects. The DIRSPACEFOR then forwarded one SSR to the JSpOC to provide weather mosaic products. The commander, JFCC-Space tasked the 2nd Space Warning Squadron and its space based infrared system ground station crew via the global STO to provide enhanced missile warning coverage. Additionally, the CAOC combat plans division tasked the Army's theater missile warning asset in the region, joint tactical ground station-CENTCOM (JTAGS-CENT), via the ATO to provide enhanced missile warning coverage and reporting as well.[16] Finally, the CAOC combat plans division also tasked the theater's Silent Sentry defensive space control system and crew via the ATO to monitor and report interference on factor SATCOM frequencies. This example shows how a successful solution for the Navy CSG transit resulted from close coordination and teaming of joint space experts all around the globe.

Importance of JFCC-Space and the JSpOC

As discussed throughout this article, forward-deployed space experts have been integral to the success of delivering space effects to the joint fight. However, the maturation of space at the operational level of war is the most significant advancement made to enable tactical successes on the battlefield. The stand-up of the JFCC-Space and the Joint Space Operations Center (JSpOC) at Vandenberg AFB, California have been key to the successful integration of space effects in theater for several reasons. First, space is inherently global and therefore the C2 of space capabilities is best conducted by a C2 function with a global perspective. Second, the commander, JFCC-Space provides the joint warfighter with a formal channel for reach-back support. In the past, JFCs and CFACCs were hesitant to reach back to another numbered Air Force's air operations center (AOC). A direct support relationship established between the CFACC and commander, JFCC-Space provides that formal link. It is essential that theater entities capture C2 agreements early on with JFCC-Space to ensure tailored space effects and support. Those agreements, combined with regular interaction and coordination, result in a unity of effort with effective, unambiguous expectations and results—effectively linking CAOCs with the JSpOC.

Figure 4. Joint Space Operations Center crew monitoring, commanding, and controlling global space capabilities.

Since its inception, the JSpOC has been growing its expertise and communicating its utility to provide a *one-stop shop* for all things related to global space planning and operations. The JSpOC allows the commander, JFCC-Space to C2 global space forces, akin to how CAOC enables the CFACC to exercise C2 of theater forces. With the 614th AOC at its core, the JSpOC is a 'functional' AOC that is organized in a similar fashion to that of a 'Falconer' theater AOC with ISR, strategy, combat plans, and CODs. On behalf of the commander, JFCC-Space, the JSpOC employs joint space experts who consider the needs of strategic and operational users all over the globe; devises space strategies that are deconflicted to meet those needs; prioritizes and develops space plans and tasking; and executes tailored space operations. From the perspective of a DIRSPACEFOR, the JSpOC provides great value by simplifying reachback as a single conduit for theater access to global space capabilities.

Conclusion

Space capabilities are changing the way America defends itself, fights its wars, and pursues national interests all over the globe. Truly capitalizing on those cutting-edge capabilities requires space experts in the right places to synchronize and integrate space into joint operations. Space experts around the world have devised innovative ways to incorporate space capabilities into the fight, are doing so today, and will continue to spur game-changing applications as they lead-turn future challenges.

Notes:

[1] "Missileman Schriever", *Time Magazine*, 1 April 1957.

[2] In November 1955 SECDEF Charles Wilson assigned responsibility for land-based ICBM development and operations to the Air Force. General Schriever retired from the Air Force in 1966, the same year one Titan IIIC rocket put eight Initial Defense Satellite Communications System satellites into orbit. In 1978, an Atlas booster launched into orbit the first test vehicle for the NAVSTAR GPS constellation.

[3] General Ronald R. Fogleman, USAF, "The Air Force and the Military Space Program," *The US Air Force in Space*, 1998, 7.

[4] General Charles A. Horner, USAF, Ret, "The Legacy of the First Space War," *High Frontier* 3, no 4 (2007): 10.

[5] The Space Warfare Center was officially dedicated in 1993. It was redesignated as the Space Innovation and Development Center in 2006. The 76th Space Operations Squadron was dedicated in 1995 under 14th Air Force and later reassigned to the 614th Operations Group in 1998 as the

genesis to the Space AOC. It was reassigned to the 21st Operations Group in 2000 and redesignated the 76th Space Control Squadron in 2001 when it assumed its current role.

[6] Early integrators were graduates of the AFSPC's Space Tactics School—a precursor to the Space Division/328th Weapons Squadron of the USAF Weapons School (USAFWS). Since 1996, the USAFWS has graduated 180 space weapons officers. The Air Force has worked hard to place these Weapons School graduates into joint theater organizations to better integrate space with combat and mobility air forces and develop effective relationships between theater-based and CONUS-based space organizations. The school continues to train tactically-focused, space-experienced Airmen who can hone space tactics, techniques, and procedures and deliver world-class space expertise to theaters and AFSPC units.

[7] Recent wartime examples of GPS-aided precision weapons include the Air Force's 250 lb-class SDB, the US Army's Guided Multiple Launch Rocket System, and its new Excalibur 155-mm artillery round. GPS also provides pin-point accuracy to the Air Force's Joint Precision Airdrop System—revolutionary GPS-aided airdrop bundles that can be dropped from C-130s and C-17s at higher, safer altitudes.

[8] Silent Sentry is also dubbed Rapid Attack Identification Detection and Reporting System Block 0. It deployed to the CENTCOM AOR in 2005 as a short-term capabilities demonstration. It proved so useful to theater commanders that it remains deployed to this day under the tactical control of the CENTCOM CFACC.

[9] Echelons and corresponding joint space professionals in the CENTCOM AOR include Multi-National Division-North Space Support Element (Iraq); Multi-National Forces-West Joint Space Support Team (Iraq); Multi-National Division-Central Space Support Element (Iraq); Multi-National Division-Baghdad Space Support Element (Iraq); Multi-National Corps-Iraq Army Space Support Team (Iraq); Multi-National Force-Iraq Air Component Coordination Element Space Weapons Officer (Iraq); Combined Joint Special Operations Task Force-Arabian Peninsula; International Security Assistance Force (Afghanistan); Combined Joint Task Force Space Support Element in Afghanistan; and space experts embedded in the Southwest Asia's CAOC and director of space forces staff.

[10] Joint Publication (JP) 1, Doctrine for the Armed Forces of the United States, 15 May 2007, IV-13.

[11] JP 3-14, Joint Doctrine for Space Operations, 9 August 2002, ix.

[12] Air Force Doctrine Document (AFDD) 2-2.1, Counterspace Operations, 2 August 2004, 13.

[13] AFDD 2-2, Space Operations, 27 November 2006, 17.

[14] CENTCOM Space Coordinating Authority Handbook v 1.0, 30 December 2006.

[15] Note the SSR process is not intended to supplant formalized ISR Tasking Processing Exploitation and Dissemination (TPED) processes. If an SSR is received by the DIRSPACEFOR and can be answered by the intelligence community, the DIRSPACEFOR passes that request to appropriate C-2/CAOC ISRD personnel to incorporate into established TPED processes.

[16] When the CSG transited the region, JTAGS-CENT was under tactical control of the CENTCOM CFACC and tasked through the air tasking order.

Col John W. Raymond (BS, Administrative Management, Clemson University, South Carolina; MS, Administrative Management, Central Michigan University; MA, National Security and Strategic Studies, Naval War College, Newport, Rhode Island) is commander, 21st Space Wing, Peterson AFB, Colorado. The Air Force's largest wing geographically and organizationally, which consists of a work force of more than 5,000 officer, enlisted, civilian and contract employees. Spanning the globe, this team provides missile warning and space control for combat forces and the national command authorities of the United States and Canada.

Colonel Raymond entered the Air Force in 1984, as a distinguished graduate of Clemson University's Air Force Reserve Officers Training Corps program. He is a career space and missile officer. He has commanded at the squadron and group levels, and served on the staffs at HQ AFSPC, HQ United States Air Force, and the Office of Secretary of Defense.

Colonel Raymond deployed in 2006 to the combined air operations center in Southwest Asia, as the director of space forces in support of Operations Iraqi Freedom and Enduring Freedom. Prior to assuming his current position, Colonel Raymond was the 30th Operations Group commander.

Colonel Raymond is also a graduate of the Squadron Officer School, Air Command and Staff College, Naval War College, and Joint Forces Staff College.

Maj Troy L. Endicott (BS, Aerospace Engineering, Embry-Riddle Aeronautical University, Prescott, Arizona; MS, Space Operations, Air Force Institute of Technology, WPAFB, Ohio) is a member of the AFSPC Commander's Action Group and delivers to a wide audience the commander's key messages as a Command speechwriter and briefer.

Major Endicott entered the Air Force in 1994. His career includes assignments as an airborne reconnaissance flight test project manager for the U-2 and unmanned aerial vehicles, orbital analyst instructor for Cheyenne Mountain Operations Center space surveillance operations, a core member on a Joint Forces Air Component Commander staff (HQ 16 AF, Aviano AB, Italy), and chief, Current Operations, HQ AFSPC Integrated Joint Special Technical Operations (IJSTO) Cell. He has deployed numerous times to theater combined air and space operations centers where he performed duties as a lead space weapons officer, space strategist, IJSTO chief, and director of space forces action officer in support of major theater exercises and combat Operations Northern Watch, Iraqi Freedom, and Enduring Freedom.

Major Endicott is also a resident graduate of the Squadron Officer School, Air Force Weapons School, and US Army Command and General Staff College.

Space, the ACCE, and the Joint Fight

Maj John R. Thomas
Executive Officer to the Vice Commander
Headquarters Air Force Space Command
Peterson AFB, Colorado

Maj Richard M. Operhall
Integration Officer
3d Space Experimentation Squadron
Schriever AFB, Colorado

Within the last several years the Air Force has made monumental improvements integrating space and air operations. Space warriors are increasingly being deployed to Air and Space Operations Centers (AOCs) around the globe to help ensure integration with the combat air forces. The director of space forces (DIRSPACEFOR) construct has likewise increased the awareness and visibility of space capabilities to the combined forces air component command (CFACC) and the commander of Air Force forces.[1] In addition, because of the global nature of space, the Joint Space Operations Center has established itself as the center of excellence for global space operations and continue to reduce the gap with the theater AOCs. In today's current fight of counter-terrorism (CT) and counter-insurgency (COIN) operations, air and space effects must be properly synchronized with ground operations in order to add value. The air component coordination element (ACCE), co-located with the ground component, serves as the primary organization tasked with synchronizing air and space effects with ground operations.

The CFACC continues to solidify and normalize the role of the ACCE in the United States Central Command (USCENTCOM) area of responsibility (AOR). As the ACCE ensures ground commanders at the strategic and operational levels of warfare understand the valuable role of air and space capabilities in CT and COIN operations, it is increasingly important for ground commanders at the lower echelons to have a mechanism effectively executing these same capabilities.

From March 2007 to present, we served as the space planner with the Multi-National Force-Iraq (MNF-I) ACCE in Baghdad, supporting Operation Iraqi Freedom (OIF). It was here we gained a greater understanding of the critical role the ACCE has in the ground fight. It was also here we realized the Air Force has a tremendous opportunity to better integrate space effects at the Army Corps and Division levels.

Air Component Coordination Element

In March 2003, US forces staged Operation Anaconda in Afghanistan, designed to kill or capture Taliban and al-Qaeda fighters based in the Shahi-Kot Valley.[2] Numerous planning failures during Anaconda highlighted the need for an air component presence at the ground component, thus leading to the creation of the ACCE construct.[3] Per Air Force doctrine document (AFDD) 2-8 :

> The CFACC may establish one or more ACCEs with the JFC's [joint force commander's] or a component commander's headquarters to better integrate air and space operations with surface operations, and with the joint task force (JTF) headquarters to better integrate air and space operations within the overall joint force. When established, these elements act as the CFACC's primary representatives to the respective commanders and facilitate interaction between the respective staffs. The ACCE also communicates the component commander's decisions and interests to the CFACC.[4]

Joint doctrine also recognizes the role of the ACCE:

> The ACCE is the senior Air Force element assisting the joint forces land component commander staff in planning air component supporting and supported requirements. The ACCE interface includes exchanging current intelligence and operational data, support requirements, coordinating the integration of AFFOR [Air Force forces]/CFACC requirements for airspace control measures, joint fire support coordinating measures, and close air support (CAS).[5]

The ACCE is not unlike other component liaisons provided to the CFACC: the battlefield coordination detachment from the Army, special operations liaison element from the combined forces special operations component commander, a Marine liaison officer from the Marines and a naval and amphibious liaison element from the Naval component. Joint doctrine states the essential role of component liaisons:

> Liaison between forces is essential for coordinated and effective joint air operations. Component commanders will exchange liaison elements to assist and coordinate the planning and execution of their component's operations with joint air operations. Liaison elements provide senior level interface for air, land, sea, and special operations forces. These elements consist of personnel who provide component planning and tasking expertise, coordination capabilities, and the ability to deconflict component operations and joint air operations.[6]

The ACCE to the ground component helps bridge the gap between the strategic and operational levels. Although the ACCE does not get involved with identifying and nominating targets for airpower, it does ensure air and space capabilities are considered and included early in strategy development and operational planning. It is important to note that the ACCE does not serve as a replacement for existing command and control (C2) relationships. Indeed, Air Force doctrine specifically states:

> The ACCE should not replace, replicate, or circumvent normal request mechanisms already in place in the component/JTF staffs. The ACCE is a liaison function, not a C2 node. It normally has no authority to direct or execute operations.[7]

Regarding the organizational structure of an ACCE:

> The make-up of the ACCE is dependent on the scope of the operation and the size of the staff they will liaise with. The ACCE should be tailored with the expertise necessary to perform effectively. Element expertise may include plans, operations, intelligence, airspace management, logistics, space, and air mobility, as needed.[8]

The war in Iraq poses unique organizational relationships for the Air Force and the ACCE. Unlike Afghanistan and HOA where US forces operate doctrinally under a JTF construct, Iraq has a unique organizational structure which does not follow standard joint doctrine.

The *ACCE Handbook* recommends that the director should be a general officer with a colonel deputy and field grade action officers. This rank structure allows for effective interaction with the ground component headquarters structure.

Multi-National Force-Iraq Air Component Coordination Element

Because of the physical separation of the CFACC from the other functional components, as well as the fact that there is a single CFACC supporting three different operational areas, the CFACC has established three ACCEs. Per AFDD, each ACCE differs in composition. The Iraq and Afghanistan ACCEs are directed by Air Force major generals, whereas the HOA ACCE is directed by an Air Force colonel who is dual-hatted as an air expeditionary group commander. The Iraq ACCE currently has the most robust staff, including a field grade officer deputy director, five planners and associated support personnel. In contrast, the Afghanistan ACCE has only one planner (a space weapons officer).

The war in Iraq poses unique organizational relationships for the Air Force and the ACCE. Unlike Afghanistan and HOA where US forces operate doctrinally under a JTF construct, Iraq has a unique organizational structure which does not follow standard joint doctrine. The MNF-I commanding general (CG) is responsible for all military operations within the Iraqi theater of operations (ITO). The ACCE director officially serves as the CFACC's personal representative to the MNF-I CG on all matters pertaining to the air component. MNF-I focuses primarily on strategic level issues with a staff organized very loosely around a doctrinal joint forces staff construct.

While the ACCE director's primary interaction is with the MNF-I CG, they also interact with the CGs of the major subordinate commands to include Multi-National Corps - Iraq (MNC-I). Day-to-day responsibilities for operational level combat planning and operations falls to MNC-I. Because of the non-standard organizational structure in Iraq, the ACCE staff is split between two locations to facilitate interaction at both the MNF-I and MNC-I levels. As stated earlier, the Iraq ACCE operates at the strategic and operational levels, ensuring early and appropriate inclusion of air and space capabilities in strategy development and joint campaign planning as well as concept of operations, contingency plan (CONPLAN), and operations plan (OPLAN) development. The ACCE performs most coordination functions at the corps since it is responsible for the preponderance of military operations in Iraq.

Air Support Operations Group and Squadron

Each of the Army Corps also has an organic Air Force element, the air support operations group (ASOG), that provides airpower expertise across the corps. As the senior Air Force representative to the corps CG, the ASOG commander serves as the corps air liaison officer (ALO), responsible for advising "their respective ground commanders on the capabilities and limitations of air power and assist the ground commander in planning, requesting, and coordinating CAS."[10] At the division level, an air support operations squadron (ASOS) commander serves as the division ALO, with the same responsibilities as the corps ALO. Army Brigades also have an ALO, while airpower is represented at the battalion level by enlisted joint tactical air controllers who form the backbone of tactical integration between air and ground forces.

In addition to the ALOs, airpower has a control node co-located with the corps (or at the division level for Operation Enduring Freedom [OEF]) known as the air support operations center (ASOC). Per joint doctrine, the ASOC is:

> The principal air control agency of the theater air control system responsible for the direction and control of air operations directly supporting the ground combat element. It processes and coordinates requests for immediate air support and coordinates air missions requiring integration with other supporting arms and ground forces. It normally collocates with the Army tactical headquarters senior fire support coordination center within the ground combat element.[11]

Because of the non-doctrinal structure of the Iraqi theater, there is potential overlap between the ACCE and the ASOG. This level of involvement and interaction requires clear delineation of the roles and responsibilities between the ACCE and the corps ALO. Again, joint doctrine specifically states:

> The ACCE is not an ASOC or tactical air control party, but acts as the [C]FACC senior liaison element and can also perform many air support planning functions.[12]

The ACCE does not circumvent any of the operational procedures established between the AOC and the corps ALO, but should enhance it.

Although the corps and division ALOs serve as the senior Air Force representatives to their respective supported Army echelons, they have typically focused solely on CAS. Due to the nature of the fight in OEF/OIF, ALOs have been forced, for better or for worse, to represent the full spectrum of airpower to include electronic warfare as well as intelligence, reconnaissance and surveillance (ISR) capabilities. Space capabilities are noticeably absent from this portfolio.

Because ALOs were representing areas out of their traditional area of expertise, CAS, the MNC-I Corps ALO submitted a request-for Air Force ISR liaison officers (LNOs) to be embedded at the corps and division levels. This began the movement to integrate airborne CAS assets with airborne ISR. The CFACC ISR LNOs provide air and space platform and process expertise to their Army counterparts, ensuring the effective integration of air- and space-borne ISR assets. Although

administratively assigned to the ASOG or ASOS, the CFACC ISR LNOs are under the operational and tactical control of the ISR division at the CAOC. This effort has been a tremendous success and has proven invaluable to the integration of air and ground operations.

Space at the Corps and Division Levels

The US Army, like the US Air Force, understands the contribution of space capabilities to operations. As such, they have spent a great deal of resources developing their own cadre of space professionals among their officer corps. Unlike Air Force officers who can spend an entire career in space operations, Army officers typically enter space operations as a senior captain or major after serving in combat arms branches. The Army system thus provides FA40s an understanding of ground combat operations that enables them to better integrate space services and effects for ground forces.

Army space officers, referred to by their functional area designation as 'FA40' are assigned to both the corps and division level.[13] At corps and division, there is a small cadre of one to two FA40s, known as a space support element (SSE), responsible for space operations in their respective organizations. According to the Army Field Manual 3-14, "the primary function of the space element is to synchronize space mission area activities throughout the operations process, maximizing the positive impact of space-based capabilities on Army land warfare."[14] These SSE serve a critical role for providing operational and tactical planning to support the corps or division headquarters.

In addition, US Army Forces Strategic Command organizes, trains and equips Army space support teams (ARSST). The ARSST provides "tailored, task-organized space resources to assist the supported command in the areas of satellite communications; position, navigation, and timing; environmental monitoring; ISR, missile warning, and other theater-tailored space information. Team members have an in-depth understanding of red, gray, and blue space orders of battle, the operational capabilities and threats imposed, and implications for land force operations." Supported commands such as MNC-I request these teams deploy to augment their current operations capability.

Space in the Iraq ACCE

The space planner within the ACCE serves as the senior CFACC space operator within the ITO, ensuring MNF-I and subordinate units consider space capabilities at the strategic and operational levels. As discussed earlier, although the Army has FA40s within the corps and divisions, the operational objective of space superiority is assigned to the CFACC by the commander (CDR) of USCENTCOM. CDR USCENTCOM has delegated space coordinating authority (SCA) responsibility to the CFACC, responsible to collect and address space requirements from the other functional components as outlined in AFDD 2-2, *Space Operations*. These two primary factors require interaction with multiple organizations within MNF-I and the CFACC staff.

Since MNF-I has no true space element or organization, the Iraq ACCE space planner's primary interaction and support is with MNC-I/C3 (command, control, and communications) space and special technical operations (SSTO). On an almost daily basis, the ACCE space planner assisted the corps space officer in identifying space requirements in support of overall ground operations across Iraq. This consisted of being a member of an operational planning team (OPT) tasked by the CG to develop an OPLAN or CONPLAN. These OPTs met as part of C3 plans for longer-term planning efforts or as part of future operations for shorter-term efforts. Regardless of the time frame for expected execution, the initial stage of planning is the right place to integrate space capabilities with ground operations. As the OPT progressed through the military decision-making process and each staff section submitted their capabilities or identified their requirements, the space planner also identified space capabilities and requirements. This level of involvement ensured integration and synchronization of ground, air, space, and information operations. In addition the MNC-I C3 SSTO was augmented by an ARSST. The ARSST team lead also assisted MNC-I C3 SSTO with on-going planning efforts, which better prepared his team to support upcoming current operations. Close interaction between MNC-I C3 SSTO, the ARSST and the ACCE space planner ensured all corps planning efforts included appropriate space effects. ACCE involvement in these planning teams pro-

Figure 1. ARSST Team Lead, MAJ John Hennessey and ACCE Space Planner, Maj John Thomas in Fallujah, Iraq, 23 July 2007.

vided unprecedented visibility to the CFACC into MNC-I operations and greatly aided space, as well as air and information operations, integration.

The ACCE space planner's primary interaction with the air component side was with the CAOC strategy division and the CFACC's DIRSPACEFOR staff. On a weekly basis, the Corps Fire Support Coordination Cell, the CAOC strategy division, the ACCE, and the corps and division ALOs conducted a video teleconference (VTC) to review upcoming division and corps level operations. This meeting ensured there is a clear understanding between the ground and air components on CAS requirements to support ground operations. Unfortunately, this meeting did not discuss any requirements for space effects. However, the DIRSPACEFOR conducts a theater-wide VTC to discuss upcoming operations requiring space support, as well as bring up any issues with current or ongoing support that needs SCA involvement. The ACCE, MNC-I C3 SSTO, the ARSST and the division SSEs participate in these weekly VTCs. So while requested air and space effects were being integrated at the CAOC, other than involvement by the ACCE staff in both air and space planning, there was no established mechanism for integration of air and space capabilities within the ground component. Although the division SSEs were planning for space effects for their subordinate units and the division ALOs planned the air support piece, there was minimal integration at the tactical level. As mentioned earlier, the collaboration and cooperation between the ACCE and the corps ALO was critical to success of CFACC operations planning in Iraq. It was this relationship, although not well-defined in doctrine, that helped bridge some of the gap between air and space planning, and integration at the operational level supporting the ground component.

The Next Step in Integration

As the executive agent for space and the service with the preponderance of space forces, the Air Force has a responsibility not only to integrate air and space activities, but also to provide space expertise to all of the services. As joint warfighters continue to increase their knowledge, understanding, and dependence on space services and effects, it becomes increasingly important for the Air Force not to focus just on air and space integration, but to integrate air and space capabilities with ground operations at the operational and tactical levels as well. There is an opportunity with structures already in place to begin that integration earlier in the planning process with the ground component. Better integration comes from strengthening some pre-existing structures and relationships, as well as pushing space warriors beyond the AOC and the ACCE, and integrating them with the ground forces through the ASOG and ASOS.

At present, there are no Air Force space planners in the ASOG or ASOS. The corps ALO should increase manning to include rated planners, space planners and, eventually, cyber planners. This construct will give the corps ALO full-spectrum air and space component planning support to the corps. In a similar manner, the Air Force should redefine the role of the division ALO to include space effects planners. Just like the CFACC provides air support to division forces and below based on intelligence preparation of the battlespace, so should a space planner with the division ALO ensure that blue force tracking, personnel recovery/combat search and rescue, overhead non-imaging infrared, space control, and additional capabilities are in place to support ground operations. Interestingly enough, the 1st Expeditionary ASOS, currently supporting the 1st Armored Division in northern Iraq, is commanded by a Space Weapons Officer. Besides the traditional role of an ALO, he has provided invaluable planning and technical expertise to the 1st Armored Division SSE. This full spectrum of support may serve as a model for air, space, and cyberspace integration with ground operations.

These recommendations would seem to minimize the role of the ACCE. Having actual planners integrated at the corps and division level, closely tied in with the AOC through collaborative networks, will minimize the impact of the physical separation between functional components on operational planning. The ACCE, however, must still maintain a role in ensuring a clear linkage between the ground component and air component at the strategic level, as originally intended.

There is obviously a manpower and training bill the Air Force will have to pay in order to implement these recommendations. At first glance, senior leaders in the Air Force will most likely talk about the force drawdown and how the personnel are

Figure 2. Lt Col Stewart Pettis (right), 1 Expeditionary Air Support Operations Squadron (EASOS) commander and space weapons officer, and MSgt Scott Loescher, 1 EASOS superintendent and Joint Terminal Attack Controller, Camp Speicher, Tikrit, Iraq, 21 January 2008.

not available to add positions to the corps and division ALO staffs. However, the benefit of having space expertise available to aid Army space personnel in planning should pay dividends in ensuring the appropriate and effective tactical integration of air, space, and ground operations. As of the writing of this article, there are more than 5,000 Air Force personnel filling Army "in lieu of" (ILO) taskings within Iraq and Afghanistan, of which 32 are space professionals. ILO taskings are those positions normally filled by Army personnel, but because of the operational and personnel tempo in the Army, they are currently being filled by Air Force personnel. In many cases these ILO positions involve convoy operations and electronic warfare operations, areas in which Air Force personnel may not be adequately trained. Space professionals are highly trained in conducting space operations and should be filling positions in theater commensurate with their training. As Army ground forces begin to draw down in theater and ILO requirements decline, the Air Force should begin to integrate space operators into the corps and division ALO staffs (i.e., ASOG, ASOS) as a permanent part of their unit manning structure. The inclusion of space operators into corps and division ALO staffs will allow these units to provide near full-spectrum air and space component effects to the ground component.

Conclusion

The time is right, and the environment is right for the Air Force to take the lead on becoming "pre-eminent in space." Just as the Air Force realized the importance of putting "air" Airmen at the corps, division, and lower levels, the time is right to realize the importance of putting "space" Airmen at those same levels. True joint integration will not be complete until the seam between ground, air, and space disappears, and there is a clear synchronization of these mediums at the strategic, operational, and tactical levels. The ALO was the Air Forces' answer to integrating air and ground. The AOC was the Air Forces' answer to integrating air and space. The ACCE was the Air Forces' answer to integrating air and space with ground at the strategic and operational levels. The Air Force now needs to address integrating air and space with ground at the tactical level.

Notes:

[1] The term CFACC is used throughout this work rather than the Joint Forces Air Component Commander to reflect the terminology used by USCENTCOM AOR.

[2] Richard B. Andres and Jeffrey B. Hukill, "Anaconda: A Flawed Joint Planning Process," *Joint Forces Quarterly* 47, (4th Quarter 2007): 135.

[3] Benjamin S. Lambeth, *Airpower against Terror: America's Conduct of Operation Enduring Freedom* (Santa Monica, CA: RAND, 2005), 204–221.

[4] Air Force Doctrine Document (AFDD) 2-8, Command and Control, 1 June 2007, 63.

[5] Joint Publication (JP) 3-09.3, Joint Tactics, Techniques, and Procedures for Close Air Support (CAS) Change 1, 2 September 2005, II-5.

[6] JP 3-30, Command and Control for Joint Air Operations, B-1.

[7] AFDD 2-8, 63.

[8] Ibid, 63.

[9] Air Force Doctrine Center Handbook 10-3, Air Component Coordination Element Handbook, 6 September 2005, 10-11.

[10] JP 3-09.3, Joint Tactics, Techniques, and Procedures, II-9.

[11] Ibid., GL-7.

[12] Ibid, II-5.

[13] Not to be confused with a branch such as Infantry or Armor, functional areas are grouping of officers by technical specialty or skill, which usually requires significant education, training and experience.

[14] Field Manual (FM) 3-14, Space Support to Army Operations, May 2005, 1-16.

[15] Ibid., C-1.

Maj John R. Thomas (BS, Texas Tech University; ME, University of Colorado; MS, Air University) is the executive officer to the vice commander, Headquarters Air Force Space Command (HQ AFSPC), Peterson AFB, Colorado. His previous assignments include; space surveillance vault officer, 1st Command and Control Squadron, Cheyenne Mountain Air Station, Colorado; missile combat crew commander and flight commander, 490th Missile Squadron and executive officer, 341st Space Wing, Malmstrom AFB, Montana; space warfare plans officer, Warrior Preparation Center, Einseidlerhof Air Station, Germany; US Air Forces Europe Combine Air and Space Operations Center chief, space operations and chief, strategy guidance, Ramstein AB, Germany; chief, strategy and policy, HQ AFSPC, Peterson AFB, Colorado. His deployments supporting Operation Iraqi Freedom include; chief, Space/Theater Missile Defense Cell, Combined Air Forces-Northern Operations Center, Incirlik AB, Turkey; and space planner, Air Component Coordination Element, Camp Victory, Baghdad, Iraq.

Major Thomas is a resident graduate of Squadron Officer School, US Air Force Weapons School, Command and Control Warrior Advanced Course, and Air Command and Staff College.

Maj Richard M. Operhall (BS, Oklahoma State University; MS, Webster University) is the integration officer for the 3d Space Experimentation Squadron (3 SES), Schriever AFB, Colorado. His previous assignments include: ultra-high frequency follow-on satellite vehicle operator and orbital analyst, 3d Space Operations Squadron, Schriever AFB, Colorado; crew commander, operations training officer and plans and tactics flight commander, 4th Space Control Squadron, Holloman AFB, New Mexico; chief, offensive counterspace and weapons flight commander, 25th Space Control Tactics Squadron, Schriever AFB, Colorado; and chief, weapons and tactics, 3d Space Experimentation Squadron, Schriever AFB, Colorado. His deployments supporting Operations Enduring Freedom and Iraqi Freedom include: crew commander, 76th Space Control Squadron (deployed), operations officer, Satellite Interference Response System, 379th Expeditionary Communications Squadron, and space planner, Air Component Coordination Element, Camp Victory, Baghdad, Iraq.

Major Operhall is a resident graduate of Squadron Officer School and the US Air Force Weapons School and has completed Air Command and Staff College by correspondence.

Air Force Tactical Exploitation of National Capabilities

Lt Col Michael A. Mras
Director of Staff
Air Force Tactical Exploitation of National Capabilities
HQ Space Innovation and Development Center
Schriever AFB, Colorado

Celebrating its 30th year, Air Force Tactical Exploitation of National Capabilities (AF TENCAP) has a heritage of success providing innovative space-based capabilities and support to tactical warfighters, intelligence, and space professionals worldwide. In August 1977, the Joint Appropriations Conference Report from Congress directed the Air Force and Navy establish a TENCAP program similar to what the Army instituted in 1973. Until 1990, AF TENCAP existed on a modest budget primarily for establishing program and organizational outreach efforts. A close relationship, which still exists today, was formed with the National Reconnaissance Office (NRO) allowing TENCAP to leverage NRO capabilities and technologies for tactical warfighters in unconventional ways. It became clear to military leaders during Operation Desert Storm that space assets could better support intelligence preparation of the battlespace and operations by normalizing national technical means (NTM) integration. As a result, AF TENCAP funding and manpower was increased to better integrate NTM capabilities into operational planning and execution.

Figure 1. 1994-1997: Weapons Guidance.

Figure 2. 1994-1997: Hook 112.

AF TENCAP Development and Emphasis Areas

Since 1977, AF TENCAP has produced and delivered many capabilities by focusing on developmental emphasis areas:

1977-1993: Disseminating Information

- Tactical Related Applications (TRAP)
- Tactical Information Broadcast System (TIBS)
- TRAP Data Dissemination System (TDDS)
- Air Defense Systems Integrator (ADSI)

1994-1997: Equipping Tactical Warfighters

- TRAP
- TIBS
- TDDS
- Attack and Launch Early Reporting to Theater (ALERT)
- Real Time Information into the Cockpit/ Real Time Information Out of the Cockpit (RTIC/RTOC) (LANCE, STRIKE I/II, COMBAT TRACK)
- Weapons Guidance / Targeting (WAGE I/II/III, ZEBRA)
- Enabling Technologies (Real-Time Symmetrical Multiprocessor, Hook 112)

1997-2003: Networks and Battlespace Situational Awareness

- EW/IO (ROYAL COACHMEN, SUTER I & II)
- Blue Force Tracking (REACH)
- GPS Enhancement (Jammer Location)
- AF TENCAP Special Applications Division Stands-up

2004-2005: Challenging Status Quos

- EW/IO (DIRTY SALLY, SUTER III)

- Blue Force Tracking (LITE)
- TACSAT (JAKE)
- Near Space (SHU/TOPPER)

2006-Present: Innovate and Integrate
- Blue Force Tracking (SHEPHERD)
- Visualization (ENDER'S CUBE/Integrated Space Situational Awareness 5.0)
- Weapons (NAMATH / HERSCHEL)
- Intelligence (CATTLe)
- Military Utility Assessment/Advanced Concept Technology Demonstration

AF TENCAP continues its commitment to NTM exploitation by rapidly prototyping emerging technologies into innovative capabilities for transition to warfighters and support agencies. From the beginning, AF TENCAP efforts remained consistent with congressional intent, and today support the Space Innovation and Development Center mission by:
- Exploiting space systems, NTM and related technologies for tactical application through creative uses of space and space-related systems. Specifically, AF TENCAP rapidly prototypes emerging space and space-related technologies and concepts, validates proofs of concept, and demonstrates capabilities.
- Providing consolidated senior-level corporate Air Force inputs into the requirements and development cycles of national, military, commercial, and civil space systems to influence their design for tactical applications.
- Supporting education and training of operational forces in emerging space and space-related technologies and concepts, as well as education of national providers about operational user requirements and environments, through participation in combat and contingency operations, exercises, and project demonstrations.

AF TENCAP Functional Areas

AF TENCAP is divided into six divisions and one cell-based upon functional areas:

Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance Division: Rapid prototyping and integration of tactical applications leveraged from emerging national intelligence, surveillance, and reconnaissance capabilities

Programmatics Division: Responsible for AF TENCAP charter development and execution.

Kinetic Effects Division: Improving bombs and cursors on target by enhancing or shortening the kill chain for global precision strike, time-critical targeting, and real-time information into and out of the cockpit by leveraging on or modification of systems operating in or through space.

Special Applications Division: Application of special technologies to augment terrestrial and airborne warfighting capabilities.

Integrated Space Situational Awareness: Rapid prototyping of visualization tools to aid total integration of emerging air- and space-based national technologies.

Commercial Integration Division: Rapidly evaluates space-related innovations. Conducts low-cost initiatives to improve space systems and tactics. Seeks out warfighter deficiencies; provides tailored solutions leveraging space architecture, procedures, and command and control. Assesses benefits of ideas through surveys, modeling and field demonstrations in a representative environment.

Irregular Warfare (IW) Cell: Based on the Department of Defense (DoD) Irregular Warfare Roadmap, AF TENCAP has consolidated previous successes and existing relationships within the IW joint and interagency community into a single dedicated team. The IW Cell will harvest critical needs from this community and address those needs with technical expertise and/or material solutions as appropriate.

Projects in Progress

Two of AF TENCAP's current projects, Talon NAMATH (TN) and the Tactical High Altitude Externals Processor (THP), demonstrate its commitment to the rapid acquisition of tools for the warfighter by leveraging existing NTM.

TN is a GPS enhancement which has significantly increased

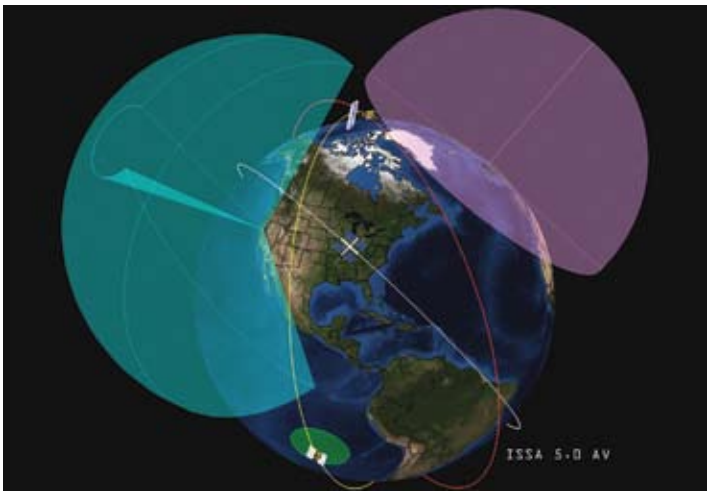

Figure 3. 2006: Integrated Space Situational Awareness.

Figure 4. 2006: Innovate and Integrate - Talon BUSHNELL.

combat strike precision via web-based architecture for guided weapons. This program enabled the first-ever operational deployment of the small diameter bomb (SDB) to US Central Command (CENTCOM) for combat use. The program increased overall SDB lethality using existing architectures while reducing opportunity for collateral damage and saving coalition and Iraqi civilian lives. TN is a flagship example of how Air Force Space Command (AFSPC) can rapidly (18 months or less) affect the battlefield performance at a low overall cost.

THP is an intelligence architecture enhancement in which AF TENCAP has leveraged high speed processor technology forging a unique ability to share tactical and national intelligence data with higher speed and accuracy than ever previously possible. AF TENCAP has deployed THP to national agencies, the CENTCOM combined air and space operations centers (CAOC), and joint task forces. THP has directly aided the ability of our engaged forces to detect improvised explosive device (IED) related activity while also increasing the speed and accuracy of traditional detection by almost 25 percent. AF TENCAP continues to forge THP into national and operational CAOC systems of record to enable greater strides toward enabling the DoD and intelligence community's collective vision of globally open intelligence architectures capable of dynamically sharing the best information. AF TENCAP is also forging promising tactical aircraft data exchange protocols to enable greater national and tactical intelligence exchange.

In addition to its responsibilities in program management, AF TENCAP has also been given oversight of two critical programs. First, AF TENCAP is the Air Force executive agent for the NRO/deputy director for Military Support Military Exploitation of Reconnaissance and Intelligence Technology (MERIT) Program and has a sitting member on the MERIT working group. The MERIT program applies Joint Military Intelligence Program funds to the development and prototyping of capabilities that increase the utility and accessibility of NRO data for the tactical operator. The NRO administers the program and annually solicits proposals from the acquisition, intelligence, operations, and scientific communities. Proposals are rated on technological feasibility, their potential to address near term requirements and joint applicability.

Secondly, AF TENCAP has been tasked as the executive agent for AFSPC's Counter-IED efforts. This is in response to the chief of staff of the Air Force direction to create an Air Force IED defeat rapid response process to identify, facilitate, and coordinate the development of new capabilities the Air Force can bring to the IED defeat fight.

Conclusion

AF TENCAP has significantly evolved during the past three decades, and will continue to evolve organizationally, changing emphasis areas as required to meet immediate warfighter needs by leveraging America's large investments in NTM and advanced technology. A diverse mix of military Air Force specialty codes ranging from scientists, engineers, program managers, pilots, navigators, electronic warfare officers, air battle managers, space and missile operators, communications and intelligence professionals enable AF TENCAP to provide rapid solutions to emerging problems. Together, AF TENCAP's 80 active-duty, reserve, Air Force civilian, and contractor personnel with their education, military specialties, and experience will continue to provide innovative solutions to expeditiously fill warfighter capability gaps.

Lt Col Michael A. Mras (BA, Aquatic Biology, University of California, Santa Barbara; MA, Human Relations, University of Oklahoma) is the director of staff, Air Force Tactical Exploitation of National Capabilities, Headquartes Space Innovation and Development Center, Schriever AFB, Colorado. He is responsible for program management, two-letter suspenses, DV visits/briefings, OPR/EPR/DECs and coordination with headquarters Space Innovation and Development Center and Air Force Space Command to answer taskings and requests for information.

Colonel Mras was commissioned as a second lieutenant in 1990 via OTS. His first assignment was to Tyndall AFB, Florida, for Battle Management training. Colonel Mras has assignments in Air Defense, NATO AWACS, Joint STARS, and Air Force level staff.

Colonel Mras has flown in Operations Allied Force, Iraqi Freedom, and Enduring Freedom. He has more than 600 hours of combat time and more than 100 hours of combat support time. In addition, Colonel Mras has deployed in support of Operations Support Justive IV and Southern Watch, and has experience with combined air operations center staffs, joint task forces, contingency operations and international relations.

No Space Capabilities—No Joint Fight

Lt Col George R. Farfour
Commander, 595th Operations Support Squadron
595th Space Group, Space Innovation and Development Center, Schriever AFB, Colorado

Maj Kenneth E. Yee
Operations Officer, 595th Operations Support Squadron
595th Space Group, Space Innovation and Development Center, Schriever AFB, Colorado

"Beat our satellites, beat us."[1]
~ Ralph Peters, 26 October 2007

Noted futurist Alvin Toffler predicted technological change would occur so quickly as to stymie people and complicate processes and activities when applied.[2] We're not there. In fact, technological change, especially when applied from and through space, has instead enabled US military operations so that war cannot be effectively waged without it. Indeed, the overall global war on terrorism, what some might regard as a low-intensity conflict, and even counterinsurgency operations in Iraq are inextricably tied to space operations and assets.

The broad mission areas of battlefield support provided via space systems has remained constant for some time, but the capabilities have increased from periphery, to "nice to have," to a "must." In its early years, space provided intelligence, communications and weather. Later, missile launch warning through surveillance and then navigation and targeting through global position and timing were added. What has changed is the dependency of military operations on these "space-supported" missions. When the first CORONA spy satellite was launched, the Air Force still operated dedicated reconnaissance versions of strategic bombers and tactical fighters. The SR-71 existed only on paper. While CORONA could access denied territory, it was not timely, had poor resolution (by today's standards), and was limited to strategic or planning value. Today, the air breathing fleets that collected intelligence are long retired, with only the U-2 and RC-135 workhorses remaining. Space has succeeded myriad aircraft in the role of intelligence collector, and its success in that role has transformed how other space assets are used in fast-paced operations that demand global access and mobility.

"The first American asset on the scene of a crisis is a spy satellite. It's why we are a superpower."[3] *~ John Pike*

The improvement in Iraqi stability and corresponding decline in US casualties is the result of the summer 2007 troop surge and change in tactics directed by the commander of US forces in Iraq, General David H. Petraeus. Key to the new strategy of limited response and presence of forces is dismounted operations; that is, troops covering terrain on foot, apart from their vehicle. Closer examination reveals success is aided through technologies applied both from and through space.[4]

Consider the improvised explosive device producer. Intelligence is gathered from space, which is exploited at various locations across the globe. Tip-off information is sent thousands of miles away to the combined air operations center (CAOC). There, the joint forces air component commander re-allocates a Predator unmanned aerial vehicle being flown from Creech AFB, Nevada, through satellite communications (SATCOM) links, using GPS for navigation. The intelligence operator sitting next to the pilot determines the facility is hostile, and an Army unit is sent in to neutralize the threat. The ground unit has situational awareness provided by the Predator through a ROVER receiver. The unit encounters resistance and a firefight ensues. The Army unit commander calls (possibly through SATCOM) for close air support from the Air Support Operations Center, which uses the Force XXI battle command-brigade and below (FBCB2, e.g., blue force tracker) that relies upon GPS data and SATCOM to verify location. A loitering, GPS-enabled F-15 employs a GPS-guided, small diameter bomb and a kill results. What's most impressive though is the confidence those on the ground have in these capabilities and of the ability to put a weapon precisely where it needs to be. That didn't just happen overnight. It took years of hard work by Airmen skilled in the employment and integration of air and space capabilities.

This vignette demonstrates space capabilities more than support the joint fight—they have become integral to the joint fight. They enabled the identification of a potential target, then through SATCOM allowed commanders thousands of miles away and halfway across the globe to decide what action to take next. Intelligence—actionable data—moved to the warfighter through space capabilities. They enabled fire support from 40,000 feet in the vicinity of *unseen* friendly troops. Space enables smaller forces; putting more capability into the hands of the warfighter, and allowing US forces the opportunity **not** to have to be there to see and hear the enemy.

As recognition that space enables the joint fight, the director of space forces (DIRSPACEFOR) CAOC position is growing of such importance that it will soon be a part of all warfighting

*Space enables smaller forces; putting more capability into the hands of the warfighter, and allowing US forces the opportunity **not** to have to be there to see and hear the enemy.*

"Space capabilities delivered by AFSPC and its partners have shaped the American way of warfare in this century, just like air capabilities shaped it in the mid-to late-20th Century." ~ *General C. Robert Kehler, Memo to Directors, Implementation Directive 08-01, 2 January 2008*

commands. The DIRSPACEFOR understands the challenges to space capabilities and advocates potential solutions with a unique skill set that enables combat operations to be better through space applications and systems. The DIRSPACEFOR is on the front line of a series of space challenges that face present and future warfighters.

First, we face an adversary aware of our capabilities and ever more capable to employ similar technologies to achieve a decisive asymmetric advantage. Increasingly, our adversaries demonstrate this, whether it be through their use of basic communications or more sophisticated means such as jamming a signal. Clearly, we must continually develop means to detect and target signals such as Silent Sentry.

Second, the electro-magnetic spectrum in the theater of operations can be extremely saturated, and requires disciplined de-confliction through the combatant command's communication experts to avoid signal fratricide.

Third, space capabilities are not cheap, and development timelines are years in the future. Decisions must be made today for systems to come on-line in 5 to 10 years, and the money to procure these satellites must be protected from other important Air Force initiatives, such as a new bomber, F-22, strategic airlift upgrades, and tanker fleet replacement. Once launched, satellites are not visibly reminding constituents of their presence—except when they fail.[5]

Finally, our adversary is adept at camouflage, concealment, and deception. However, space and literally space-age technology can defeat their efforts. The Space Innovation and Development Center has shepherded a number of military utility assessments that have validated imagery technologies and techniques that can aid in the identification of targets and hidden threats. The Air Force must never lose the will to spend resources on innovation, where small investments can have huge rewards.

"If you were America's enemy, would you charge out to take on our tanks, warships, and aircraft? Or would you rather paralyze them all?"[6] *~ Ralph Peters*

Realistically, however, a list, even a partial list of space capabilities does not tell the full story of how dependent the joint fight is on those capabilities. To garner a more accurate appreciation, one must examine what would change if those space capabilities were simply not there. In this exercise, loss of several key satellites and their corresponding capabilities points to a dark scenario. We would essentially be fighting with technology 40 years old or older. General Barry McCaffrey, USA, retired, contends, "We will drop back to WWII era capabilities if we suddenly lose our space advantage."[7] Any loss of our space capabilities would be a devastating blow to our national defense, but regardless of far it might place us back, the central question to consider is, "Could we overcome such a deficit?"

The Chinese anti-satellite test (ASAT) demonstrated the relative ease with which such a scenario could unfold. But the issue goes beyond the destruction of low-Earth orbiting (LEO) satellites, to the denial of capabilities those satellites provide. As a physics problem, interrupting, scrambling, jamming, or disabling a satellite's signal is unsettlingly easy. Further, disabling terrestrial command and control centers and downlink/relay (bent pipe) sites is another method to radically truncate our advantage in space.

Taken together, a coordinated assault on ground and space-based assets could not only negate, but even reverse our superiority in space.[8] Air Force Space Command Commander General C. Robert Kehler has observed, the capabilities of our space forces, when combined with air and cyberspace is not simple addition, for example, 1 + 1 = 2. It is more like 1 + 1 + 1 = 1,000. Likewise, the loss of space from the equation is not a simple subtraction.[9] Loss of even some of our space forces would have an exponential impact on air and cyberspace capabilities. Michael J. Coumatos and his fellow authors outline just such a scenario and rather realistically chronicle its impact in their book, *Space Wars: The First Six Hours of World War III*. And likewise portraying how we might overcome such an attack, their work serves as an extremely useful guide to illustrate just how hobbled our armed forces and commercial sectors might become in the event of such an attack.[10]

The most obvious deficit would be the loss of the GPS timing and navigation signal. GPS-guided and -aided munitions would revert to their previous "dumb bomb" status. Without the precision offered by GPS, weapons would become much more inaccurate, and collateral damage would increase exponentially from Air Force and Navy bombs and even Army artillery. Laser-guided munitions—technology from the 1960s—would become our most accurate weapon. The loss of highly accurate global navigation would result in a negative ripple effect in the world economy of staggering proportions. Navy personnel would be forced to re-learn the sextant. Aircrews traversing the great expanses of oceans we do daily with ease now would have to spend many more hours planning sorties with dead reckoning procedures from their manual flight planning calculators. The commercial airline industry might be so severely limited it might never recover without significant government assistance. Along with disabling other commercial sector satellites, cell phones, blackberries, and pagers would cease to work dependably. Global financial transactions would be severely limited, untold conveniences would die away, even for a time, like pay-at-the-pump credit transactions, a large sector of television transmission, and so forth. The world would grow much larger.

Figure 1. The Defense Meteorological Satellite Program mission is to generate terrestrial and space weather data for operational forces worldwide.

Without the Defense Meteorological Satellite Program and other satellites, predicting weather would become more of an art form, requiring increases in manpower and time.[11] Combat aircraft employing laser-guided munitions would likewise be affected, as greater sortie generation would be required to get an accurate laser lock, a feat greatly enabled by accurate weather predictions in the 1960s. Sortie-to-target destruction rates would climb to levels not seen since the Korean War, further straining supply lines for precious fuel and repair hardware. The navigation morass would grow for oceangoing vessels as transit times would increase further as storms could not be as accurately avoided.

Reachback, a word that has grown to demonstrate our superior prowess at moving inordinately large amounts of information across thousands of miles and enabling fewer forces forward, would not mean the same thing. Internet access would require hard points, and transmitting data would be so inhibited it would become virtually useless as a form of global communication. Numerous capabilities drawn from Web-based applications would fail as access dwindled.[12] For warriors, there would be very little dependable communication traversing the vastness of geography made smaller by satellites. Global secure communication would vanish when our military satellite communications and other satellites were disabled. Even the possibility of falling back to telegrams is not an option as Western Union stopped the over 150 year old service on 31 January 2006, overcome by the shrinking of the globe made possible, in large part by space assets.[13]

Essentially we would have no eyes, ears, or voice which would profoundly impact our ability to act. Further, such a strategic attack would severely limit our ability to not only conduct current operations, but place at serious risk the protection of our own forces in the field. We would quite likely surrender the offense and fall back to a largely blind, deaf, mute defense posture. Our foreign policy could sink helplessly as the rest of the world watched the proverbial Gulliver fall and sleep. The second and third order effects, many of which are unknown would take a tome to describe and it is quite likely that we would wake-up tied with a million lines.

Militarily, the overall impact would result in power projection, global reach, and global dominance becoming interesting historical phrases—nothing more. The worldwide impact would take months, perhaps years to realize and would make the terrorist attacks of 9/11 and their impacts look like a speed bump by comparison.

Many purveyors of airpower theory still talk at great lengths of integrating space into the joint fight as if it has not started or is still in the infant stages of integration. Certainly, in the military, our moniker has long been "for a greater need to integrate _____" (fill in the blank), and "space" has been one of them. Too many times examples of just how integrated space capabilities are overlooked to make a point. While there is little debate bringing greater space capabilities to the warfighter is a good thing, the few examples above prove we are far more integrated into the joint fight than many believe or are willing to admit. The integration that pays the most dividends is integration of doctrine, concepts of operations and tactics, techniques, and procedures at the front end of space and weapon development vice our traditional focus on integration at the sharp end of the spear.[14] Though it is not a one-for-one swap by any means, space integration must recognize the greater need of protecting our space advantage. Thankfully, recent increases in congressional appropriations will start to make a difference soon, if continued.[15]

While future space capabilities will continue to expand our advantage in the joint fight, without concrete action to protect and even defend that advantage it will make the likelihood of a debilitating attack even greater. Regretfully, the warnings contained in this article are not new, they have been around for quite some time, but as time and technology march on, the US grows more dependant on these capabilities and thus more vulnerable to having them attacked and negated.[16]

"Space is the backbone of our national security. It must not become our Achilles' heel."[17] *~ Robert Stevens*

A challenge, though theoretical at this point, has been made, how do we answer? The first steps have already been taken and the US is moving forward, and our leadership is using the opportunity granted by the Chinese ASAT demonstration to illustrate many of the points made above to the public.[18] The US must first determine the types of threats to our space assets, increase our ability to monitor those and emerging threats, and protect our assets in space. In the future the US must even

begin to think about not only how we protect our satellites, but how we might negate an adversary's threat to our space advantage ***from space***.[19]

As General Kevin P. Chilton and General Kehler have repeatedly said, space situational awareness is an area where we need to pay attention, especially after China's ASAT demonstration.[20] Our commitment must go beyond recognition of the threat—it must include action. Our investments in space protection must also increase. If we do not act now to resolve these potential gaps, it will become a canyon over which we may not be able to jump. Space capabilities no longer simply support the joint fight, they enable the joint fight to such a degree that it is not too far of a stretch to say, ***without space, there is no joint fight***.

"We are placing our national security at enormous risk if we do not soon act to correct these crucial shortfalls."[21]

~General Barry R. McCaffrey, USA, retired

Notes:

[1] Ralph Peters, "A Maginot Line In The Sky: Beat our Satellites, beat America," *New York Post*, 26 October 2007.

[2] Alvin Toffler, Future Shock, (New York, NY: Random House), 1970.

[3] John Pike, as quoted in Gayle S. Putrich's article "US Air Force: Don't Short Space Programs," *Military Space*, 9 April 2007.

[4] SSgt Jeremy Larlee, PACAF commander stresses importance of space, Air Force News Agency, 17 April 2007.

[5] Staff Writers, SpaceWar: Your World At War website, "US Space Commander Discusses Future Space Capability-Part 1, http://www.spacewar.com/reports, 25 September 2006.

[6] Peters, "A Maginot Line In The Sky."

[7] General Barry R. McCaffrey, *After Action Report: Visit Nellis and Scott AFB, 14-17 August 2007*, 15 October 2007.

[8] Dave Montgomery, "Military Planners Mull Possibility of Cyber War," *Kansas City Star*, 26 November 2007.

[9] General C. Robert Kehler, to the Air Force Association, Los Angeles, CA, 16 November 2007, speech, http://www.afspc.af.mil/library/speeches/speech.asp?id=356; Lt Col George Farfour, author, personal notes taken during SIDC discussions with General Kehler, 3 December 2007.

[10] Michael J. Coumatos, et al, *Space Wars: The First Six Hours of World War III*, (New York, NY: Forge, 2007; Walter Pincus, "Space Defense Program Gets Extra Funding," *Washington Post*, 13 November 2007.

[11] Other National Oceanic and Atmospheric Administration (NOAA) satellites include Polar Orbiting Environmental Satellite (NPOES) and Geostationary Operational Environmental Satellites (GOES).

[12] Sam Diaz, "Military Says Bandwidth Alone Forced Web-Site Blocking," *Washington Post*, 18 May 2007; William H. McMichael, "Moving Data Faster Without Human Help," *Air Force Times*, 26 November 2007.

[13] Western Union, http://westernunion.com/info/osTelegram.asp.

[14] Farfour, author, personal notes.

[15] Pincus, "Space Defense Program Gets Extra Funding."

[16] Peters, "A Maginot Line In The Sky."

[17] Robert Stevens, chairman, president and CEO of Lockheed Martin, speech, 23rd National Space Symposium, Colorado Springs, CO, 10 April 2007, reported by *Defense News*, 16 April 2007.

[18] John T. Bennett, "Chinese ASAT Missiles Creates 'Gaps' for US Military, Commander Says," *Defense News*, 19 November 2007; Raymond E. Johns, "Money Well Spent," *Washington Times*, 10 May 2007.

[19] Bill Gertz, "US To Defend Space With Military Force: Warns of Threat to Infrastructure," *Washington Times*, 14 December 2007; Andy Pasztor, "US Asserts A Military Option Is Needed To Guard Space Assets," *Wall Street Journal*, 14 December 2007.

[20] Gayle S. Putrich, "China's ASAT Test Is Talk of Space Confab," *Defense News*, 16 April 2007; Capt Jennifer Whitaker, "Chilton: 'We Cannot Afford To Be Surprised'," *Air Force Print News*, 26 June 2007; General C. Robert Kehler, speech, 16 November 2007.

[21] McCaffrey, *After Action Report.*

Lt Col George R. Farfour (BS, East Carolina University, MA, Webster University, MMOAS, Air University) is the commander, 595th Operations Support Squadron, 595th Space Group, Space Innovation and Development Center, Schriever AFB, Colorado. He entered the Air Force as an ROTC distinguished graduate in 1989. Immediately before taking command, Colonel Farfour served as a National Defense Fellow assigned to the International Security Program, Center for Strategic and International Studies (CSIS), Washington, DC. He has held a variety of operational and staff duty positions in ICBM operations, Satellite Command and Control, joint nuclear planning, the Air Staff and Headquarters, Air Force Space Command (HQ AFSPC). When assigned to HQ AFSPC, he served as the deputy director of the Commander's Action Group. While on the Air Staff, Colonel Farfour was responsible for strategy and concepts planning for nuclear policy and was the Air Force's action officer for the Nuclear Posture Review. He also was responsible for the Air Force's policy and compliance with space arms control treaties and agreements including the most politically charged treaty of the post Cold War era, the Antiballistic Missile treaty. Colonel Farfour is a graduate of Squadron Officer School, Air Command and Staff College, Air War College (by correspondence), and in-residence SDE as a National Defense Fellow. He is a Credentialed Space Professional earning the Command Space Badge. Colonel Farfour is the author of several published works on nuclear policy, space operations, military history, and current events.

Maj Kenneth E. Yee (BS, USAF Academy; MS, National Defense Intelligence College) is the operations officer, 595th Operations Support Squadron, 595th Space Group, Space Innovation and Development Center, Schriever AFB, Colorado. He entered the Air Force in 1994. Prior to serving as the squadron operations officer, Major Yee was the Intelligence Flight commander, providing intelligence to three center divisions and four squadrons in the 595 Space Group. He is a career intelligence officer, with experience across six MAJCOMS in acquisitions, intelligence analysis, flying unit operations, intelligence training, and systems integration. Major Yee has deployed in support of U-2S collection operations, F-15E interdiction missions in Operations Allied Forces and Enduring Freedom. He has served as the intelligence officer course chief, responsible for the training and education of all Air Force intelligence officers. Major Yee is a graduate of Squadron Officer School and Air Command and Staff College (by correspondence). He is a Credentialed Space Professional and also serves as the Senior Intelligence Officer for the Space Innovation and Development Center.

The Space Triad: A Joint Concept for Space Power

Maj Charles S. Galbreath
Program Manager
Advanced Space Control Demonstrations
Space Superiority Systems Wing
Space and Missile Systems Center
Los Angeles AFB, California

Path to a Space Triad

The United States is at a critical stage in its development in the space domain. The successful exploitation of space has simultaneously led to an unparalleled military advantage and an unintentional invitation to potential adversaries to develop means to deny and disrupt space capabilities. Space power is an increasingly critical factor shaping US security and America's way of life. Unfortunately, a combination of external threats and internal challenges are eroding US space power. The US must adopt a comprehensive strategy to deal with these diverse challenges or face losing its advantage in space.

The objective of this article is to identify needed families of capabilities and describe how those families should interact with one another, with other military capabilities, and within the suite of national power instruments to preserve an advantage in space. A triad approach, consisting of offensive, defensive, responsive infrastructure capabilities tied together by situational awareness, command and control (C2), and integrated planning, is the best approach to space power. Before proceeding with a discussion of the space triad, it is important to understand the historic views about the space domain, the utility derived from it, and the challenges the United States' faces as a space power.

Sanctuary or Control?

"If liberty and freedom are to remain in the Earth, the United States and its allies must be in a position to control space."
~ General Thomas D. White, USAF chief of staff, 1958[1]

At the dawn of the space age, General Thomas D. White recognized space as a domain, similar to the air and maritime domains. This realization led many to see a need for space control, just as the US could gain control of the air or maritime domains in a time of conflict. This control doctrine would create the abilities to have freedom of action in space and to deny that same freedom to adversaries. President Dwight D. Eisenhower, however, directed a sanctuary doctrine.[2]

The desire to preserve space as a sanctuary largely stemmed from the need to have unrestricted means to monitor Soviet nuclear activities, thus reducing the fears and uncertainty of the Cold War. The sanctuary doctrine became the concept for space development in the 1950s, 60s, and 70s. As a result, space activities largely fell into two camps: classified military programs and visible civil activities. In fact, President Eisenhower decided to create the National Aeronautics and Space Administration (NASA), separate from the Department of Defense (DoD), in part to preserve the sanctuary doctrine. For over two decades, the sanctuary doctrine provided a sound foundation allowing unimpeded monitoring of Soviet nuclear arsenals and thus maintained a stable, albeit tense, status quo.[3] However, the unique benefits of space to enhance military effectiveness would lead to a changed view of space.

Utility of Space

In the 1980s, the establishment of Air Force Space Command (AFSPC) signified the emerging military utility of space systems beyond supporting national-level activities. This helped highlight the need to preserve future access to space and, if needed, deny the same access to adversaries. Before the standup of AFSPC, Air Force Systems Command developed, acquired, and operated the majority of all US military satellites. The shift to the more "operations-oriented" AFSPC separated the development and acquisition of space systems from operations and helped focus space capabilities to support military operations vice strictly supporting national-level objectives. This approach paid dividends during the 1991 Persian Gulf War, referred to by many as the first space war.[4] The result of the United States' successful space exploitation during Desert Storm brought about an intense interest in furthering space capabilities and their utility to combat operations and daily life.

The expansion of the utility of commercial space systems presents national security space experts with a two-edged dilemma. On one hand, many commercial providers and allied nations can augment the existing suite of government capabilities. The most profound example of this is the amount of communication bandwidth provided to the military over commercial systems. Estimates from Operation Iraqi Freedom place the level of commercially provided satellite communications at more than 80 percent.[5] On the other hand, if unchecked, adversaries could easily exploit these same space capabilities, nullifying the US advantage.

Beyond the military advantages of space are the day-to-day, often unseen or overlooked, benefits of space enjoyed by the nation and the world. For example, satellite communication and the timing signal of GPS enable global electronic financial transactions. Further, space itself has become a boom industry for the nation; with commercial satellite imagery; satellite communication, television, and radio; GPS user equipment; and the newest space industry to emerge—space tourism. Naturally, potential adversaries have watched and taken note of the US's exploitation and growing dependence on space capabilities.

Threats to Space

The intelligence community has clearly enumerated the threats to US space systems. In 2005, the National Air and Space Intelligence Center published *Challenges to US Space Superiority*. This document identified foreign interest and development of space object surveillance and identification; as well as technologies to attack the ground, link, and space segments.[6] In recent Congressional Testimony, Lt Gen Michael D. Maples, director Defense Intelligence Agency, stated numerous states and non-state groups are actively seeking capabilities to counter the United States' exploitation of space.[7]

Current events clearly illustrate these threats are increaing. While not particularly effective, one of the first adversary use of anti-space weapons in combat occurred during Operation Iraqi Freedom. The Iraqi regime attempted to counter the US utilization of the GPS constellation through a series of ground-based jammers. Like their military counterparts, commercial systems are not immune from attack. In 2003, there was an intentional jamming of two transponders of Telstar-12, disrupting broadcasts to Europe and the Middle East. The apparent target was a Voice of America Persia broadcast intended for Iran.[8] More recently, reports indicated Chinese use of ground-based lasers to dazzle imagery satellites. Finally, 2007 began with a Chinese demonstration of a direct ascent, kinetic kill anti-satellite (ASAT) system.[9] In the coming years, the potential for attacks against space systems, by state and non-state adversaries, becomes increasingly possible. Clearly, space is no longer a sanctuary.

Internal Challenges

Unfortunately, threats to space power are not all external. A tendency to stovepipe space capabilities, lengthy acquisition development timelines, and cost overruns often prevent maximum utilization of, and advantage in, the space domain. While similar criticisms are possible for any major defense acquisition effort, the limited number of space capabilities intensifies the impact of developmental difficulties. In addition to the widely publicized acquisition difficulties themselves there are several consequences impacting space power.

As the United States military fields fewer new systems, the relative criticality of each operational system increases. This coupled with the lack of immediate replacement creates a precarious protection footing.

Acquisition problems also impact the effective utilization of space. The desire to capture scarce procurement dollars leads many system developers to seek breakthrough, proprietary technologies to stand out among the competition, rather than using proven and more widely available technologies. Compounding this is the number of different national security organizations operating space systems, each with their own concepts and approaches.[10] The resulting stovepiped systems are difficult to integrate with one another and limit the flexibility needed to respond to dynamic situations.

Finally, the combination of increased budget pressure and lengthy development timelines leads to a reduction in cadre of professionals working in the military space field. As the 2001 Space Commission Report identified:

> The aerospace and defense industries overall have seen their appeal battered by declining stock prices, steady layoffs, program failures, and cost and schedule overruns. Without a sufficient base of interesting, leading edge technology programs, it is increasingly difficult for both industry and government to attract and retain talent.[11]

The shrinking pool of talent decreases the nation's industrial base and ultimately its relative competitiveness to other nations.

The Space Triad

The proposed space triad represents the needed capabilities to achieve desired effects in the space domain. Like the current strategic triad, the space triad consists of the three main sections (offense, defense, and responsive infrastructure) brought together by an integrated situational awareness, C2, and planning core.[12] While the overall objectives of each section are the same as the strategic triad, based on the unique nature of space operations vis-à-vis strategic deterrent operations, the components of each section differ slightly from the strategic triad.

The Space Triad in Multiple Domains

Before proceeding with an in-depth discussion of each subset of the space triad, it is vital to discuss the interrelationship of the space domain to other domains of military operation. The Capstone Concept for Joint Operations (CCJO) identifies nine domains to influence a target system. The CCJO groups these nine domains into the physical domains of air, land, sea, and space; the virtual domains of cyberspace and information; and the human domains of social, moral, and cognitive. The CCJO stresses the importance of acting from multiple domains in an integrated and interdependent manner.[13] Since the human domains will depend on a particular adversary or operation, they are beyond the scope of the general discussion associated with the space triad. Further, while all nine domains are relevant for military discussions, only the air, land, sea, space, and cyberspace domains currently have concerted militarily operational efforts. Therefore, these five domains are the focus of domain discussion related to the space triad. Three key points regarding these five domains are important to highlight before continuing the space triad discussion.

The first key domain point is that while each domain has inherent specialties, all domains provide combat effects. Therefore, some doctrinally defined space missions are simply part of a larger set of inter-domain missions (figure 1). Space force enhancement (SFE) and space force application (SFA) missions, for example, are combat support. While part of the overall space power family, they are not a means to assure space power. Consequently, these mission areas are outside the scope of the space triad discussion.

Second, even though all domains interact, the linkage between the space and cyberspace domains is particularly acute. More than any other domain, space is dependent on the cyberspace domain. Since the cyberspace domain encompasses the entire electromagnetic spectrum, all information and services from the space domain transit the cyberspace domain.[14] Due

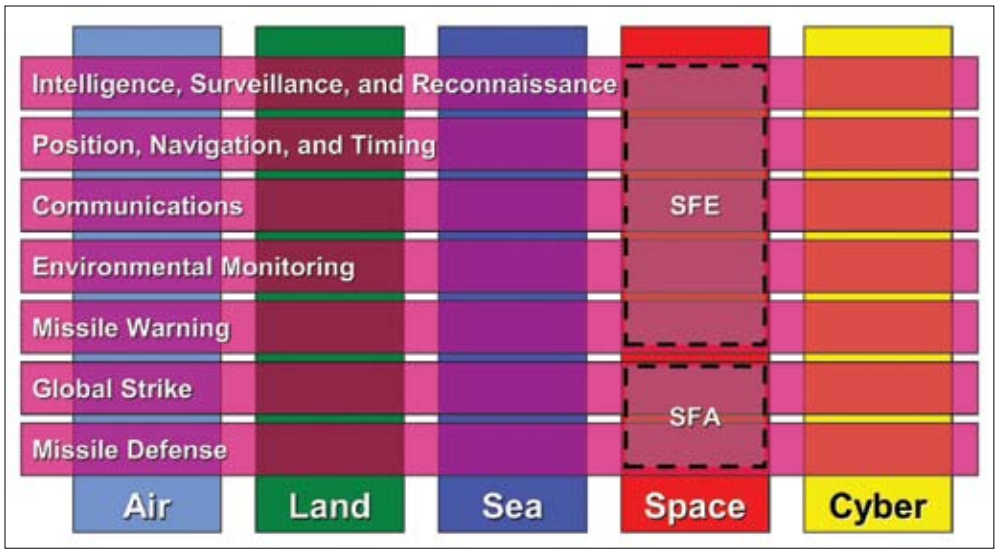

Figure 1. Space Missions and Domains.

to the extreme ranges involved in space operations, the day-to-day C2 of space systems must occur via the cyberspace domain. Additionally, many threats to space systems are from the cyberspace domain, including lasers, jamming systems, and network attacks. As the space and cyberspace domains evolve, this interaction will undoubtedly also evolve. However, as an entering point for discussion, the cyberspace domain is a unique domain. Therefore, many of the aspects traditionally considered space operations are cyberspace operations, and beyond the scope of the space triad.

Finally, while space is typically a supporting domain, when necessary, the other domains can provide support to achieve the desired space effect. For example, a ground or cyberspace attack against an adversary's satellite control facility may achieve the desired level of space denial without entering the space domain itself. To maximize combat utility and economy of effort it is essential to integrate the planning, C2, and situational awareness of all domains, as identified in figure 2. With these points understood, a detailed discussion of the space triad is possible.

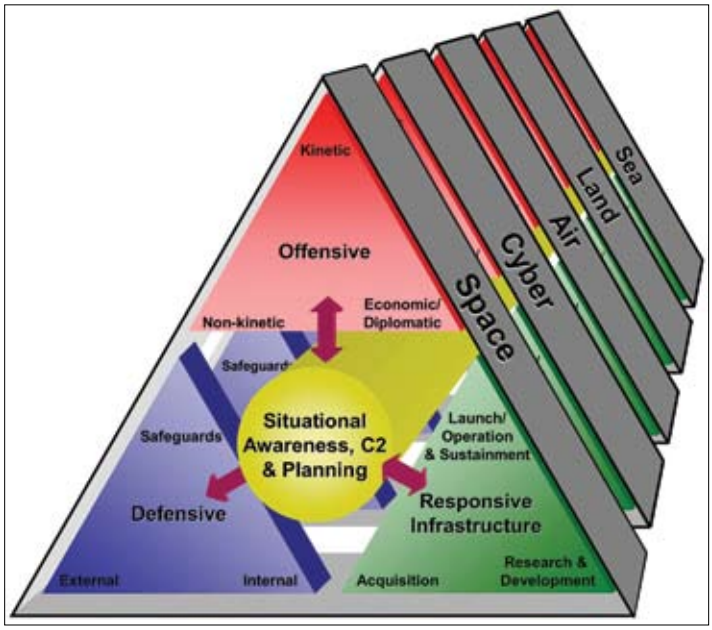

Figure 2. The Space Triad and Domain Interaction.

Offensive Capabilities

The goal of the offensive section of the space triad is to possess the ability to deny an adversary the benefits of space capabilities. Like the new strategic triad, the need for precision pervades all aspects of offensive capabilities. Unlike the new strategic triad, nuclear options are not applicable within the space domain. This restriction is based on Article IV of the 1967 Outer Space Treaty banning nuclear weapons in orbit, the desire for precise effects, and the political and military ramifications of a nuclear strike.[15]

In place of nuclear options are diplomatic and economic means to dissuade or hinder others from developing or fielding space capabilities counter to US interests. One example of such an approach is the Outer Space Treaty limiting certain actions in orbit. The White House has repeatedly stated the US "will oppose the development of new legal regimes or other restrictions that seek to prohibit or limit US access to or use of space."[16] This restraint does not prevent the United States from using political and economic means entirely. For example, the US has entered agreements with private satellite providers to preclude adversary access to space-based imagery.

Economic and diplomatic methods are practical in a long-term, deliberately planned approach to help shape the environment of future operations. Unfortunately, crises will emerge, requiring quicker response options. For these instances, the United States must develop both kinetic and non-kinetic means of denial. While in a general sense, economic and diplomatic means of space denial are non-kinetic, the distinction of who delivers a non-kinetic capability necessitates a separate subcategory. Within the space triad, non-kinetic refers specifically to military actions.

Military non-kinetic capabilities represent an escalation beyond the economic and diplomatic options discussed earlier. Even with this escalation, non-kinetic means offer three distinct advantages. First, with their escalation they can more emphatically convey national will. Second, they offer the ability for rapid restoration of an adversary's capabilities upon cessation of hostilities. Finally, unlike kinetic options, non-kinetic options are capable of achieving their desired effect without the danger of creating orbital debris.

The final subset of offensive capabilities is kinetic options and represents the highest level of escalation and the greatest risk of suffering unintended consequences. Co-orbital and direct ascent ASAT weapons are not reversible and will likely cause orbital debris. Additionally, despite the fact that space is not a sanctuary, kinetic options will likely be widely con-

demned by the international community and many within the US for the foreseeable future. Further, as multination partnerships and civilian conglomerations continue to expand their delivery of satellite technologies, kinetic options will become less appealing, due to the inability to avoid collateral damage. The one distinct advantage of kinetic options is in their ability to ensure the target satellite is no longer operational.

Defensive Capabilities

The United States must devote considerable attention to defending and protecting its space capabilities. This defense not only provides security for specific platforms, but more importantly for the type of capability provided from space and the US's assured access to key regions of space, what John J. Klein calls celestial lines of communication.[17]

Two factors characterize the types of defensive options: the timing and the focus of the action taken. As illustrated in figure 3, the level of available warning and timing of an attack or incident characterizes the level of threat. The three levels of timing are ambiguous warning, unambiguous warning, and post attack/incident. The focus of action can either be internal to US and friendly capabilities or external and focused on diminishing the effectiveness and/or duration of the adversary's attack or incident. During a period of ambiguous warning (day-to-day), the United States must seek safeguarding measures to assure successful delivery of space derived capabilities and continued use of key space staging points. Safeguarding measures can include a wide variety of means including, hardening, redundancy, maneuverability, and so forth. During the period of unambiguous warning, the US can choose to preempt an adversary attack or initiate measures to avoid the attack/incident. In some cases, this may mean implementation of safeguarding measures. Once an attack commences or incident occurs, the US can suppress the attack and take action to restore the lost or degraded capability.[18]

The combination of all defensive options affords the greatest amount of flexibility to the nation and creates a multi-layered defensive posture. Given the growing uncertainty of future conflicts and the range of potential challenges, it is only prudent to have a flexible defensive architecture. Only through the planned development of all available defensive capabilities will future commanders have the ability to effectively implement the appropriate response to a given situation. Further, the totality of defensive options creates a formidable barrier for any would-be attackers.

Responsive Infrastructure

While the strategic triad examines entities such as technology, academia, and industry as the three subcomponents of responsive infrastructure, the space triad focuses on capabilities.[19] This approach increases the parallel between the main sections of the triad. While technology, academia, and industry are all essential to a responsive space infrastructure; the focus should be on the capabilities these entities provide or rely on. Therefore, the responsive infrastructure of the space triad refers to: research and development (R&D), acquisition, and satellite launch, operation, and sustainment.

R&D contributes to space power in three primary ways. First, R&D is critical to mature technologies for use later in future systems. New advancements must undergo a series of tests to ensure the technology is operationally feasible and suitable for the space environment. Second, R&D efforts can provide operational utility once the demonstration of the viability of the technology is sufficiently complete. Research efforts, should ensure any residual capabilities are available for post-test operational planning and use. To improve the ease of transition, the operational community must be knowledgeable of the R&D efforts from the beginning. Overly restrictive classification measures often prevent this. Finally, the pursuit of new technologies and capabilities can serve as a deterrent to potential adversaries or lead them to pursue avenues advantageous to the United States.

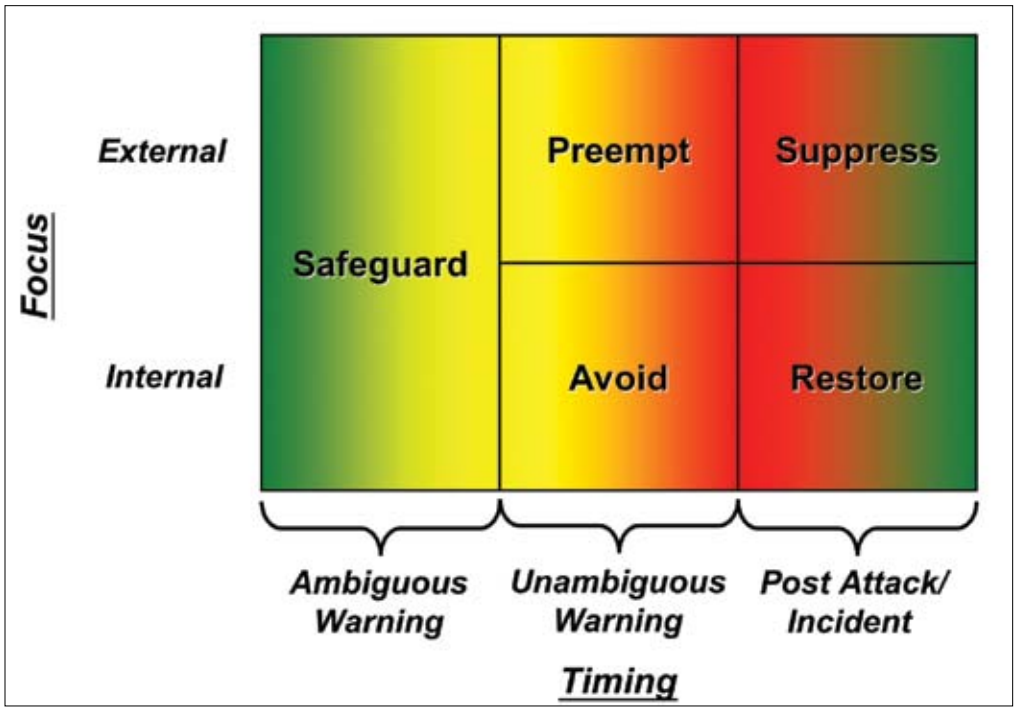

Figure 3. Defensive Options.

Provided with proven technologies from previous R&D efforts, the acquisition community can now produce systems for operations. Bearing in mind the protection concerns of overloading too much capability on a single platform, the acquisition community should shift to include smaller, single purpose systems or with smaller mission sets. This will shorten development timelines and decrease overall program costs; while simultaneously reducing the

criticality of any one satellite, thus improving the US defensive posture. While the use of single purpose systems will require extra launches, the smaller payload may enable the use of smaller, less expensive, and more responsive boosters.

Shifting to increased use of smaller payloads opens options in the launch, operations, and sustainment realm. As previously mentioned, smaller payloads will lead to the use of smaller boosters. These smaller boosters may allow the utilization of an expanded suite of launch options and bases, including the use of air and sea launch vehicles. This will decrease the reliance on the two US launch ranges, decrease time to place payloads in orbit, and make the US less susceptible to a catastrophic incident at any one base. Once in orbit, space systems require operations through interoperable, net-centric satellite C2, to ensure the health, status, anomaly resolution, and support to users.[20] Adopting a net-centric approach to satellite control will enable a more rapid check-out of newly launched satellites, greater number of contacts per day to support the increased number of payloads launched, and decrease the significance of any single ground station. Finally, with a decreased time to launch and increased capacity for satellite control, the prospects of launching supply, repair, and upgrade missions increase. This will increase the flexibility of the US space infrastructure. Further, this will be a key factor enabling many of the defensive and offensive means of achieving national and military objectives.

Situational Awareness, Command and Control, and Integrated Planning

A combination of situational awareness, C2, and integrated planning enables all space operations. Situational awareness provides the requisite knowledge for current operations, as well as an assessment of the projected space situation to guide research and acquisition activities. C2 coordinates and directs available capabilities to accomplish the needed missions. Interwoven within C2 is the need to conduct integrated planning to determine the optimum use of available resources, regardless of domain.

Situational awareness, particularly space situational awareness (SSA), must focus on enabling other functions within the space triad. To accomplish this, SSA must be able to provide timely status, capabilities, limitations, and projections of friendly, neutral, and enemy space forces, and the operational environment. Included in this is the need to assess adversary intentions and capabilities, in the near-, mid-, and far-term. Further, SSA must be able to predict, identify, and attribute attacks against US space capabilities. Finally, situational awareness must extent beyond just the space domain, to include insight into air, sea, land, and cyberspace activities of potential consequence to space capabilities. All this information must be available within a user defined interface to support effective planning and C2.

Fundamentally, space C2 must translate national objectives and the joint force commander's intent and objectives into actionable tasks, directing appropriate forces to accomplish those tasks, and assessing their effectiveness.[21] To accomplish these roles, the United States must have a means to effectively connect operational units, joint functional component command (JFCC) for space, other JFCCs, forward headquarters, and agencies in a net-centric and collaborative environment. With JFCC-Space serving as the central point of control for global space activities, networked C2 will ensure appropriate execution of space tasks around the world. This interconnected C2 capability makes an integrated planning process with diverse cells around the world possible.

Given the limited availability of space resources and their continued criticality to military operations, an integrated planning process is vital to ensure maximum utilization to the greatest number of operations around the world. An integrated planning process can ensure operations in all domains interact to achieve desired objectives and avoid costly duplication of effort, or worse unintentional degradation of friendly capabilities. On a global scale, this integrated planning may see space activities simultaneously act in both supporting and supported roles. Whatever the role, clearly integrated situational awareness, C2, and planning capabilities are essential to ensuring the US's space power today and into the future.

Application

The 2001 Space Commission Report warned of a "Space Pearl Harbor."[22] While some think this warning was alarmist, such a concept does represent the most dangerous course of adversary action.[23] For that reason, it is worth investigating to determine how the space triad concept might prevent or diminish the severity of such an attack. First, it is important to understand the context, objectives, and means potentially embodied by a "Space Pearl Harbor" attack.

Assuming conflicts will continue to be waged for terrestrial objectives, a "Space Pearl Harbor" will likely be a prelude to an imminent terrestrial attack. To effectively utilize all available options in a surprise space attack, a potential adversary will require technical skills and staging points. Such robust capabilities are reasonably only available to state actors, most likely a near-peer competitor. Presumably, such an adversary will be reliant, to some extent, on space capabilities themselves. Their logical objective would be to nullify US space capabilities, while preserving their own, as a precondition to engage in terrestrial operations to achieve objectives. This attack may manifest rapidly, to overwhelm the US ability to respond, or gradually, attempting to imperceptibly erode the US advantage in space. In either case, through effective use of the capabilities identified in the space triad, the United States can prevent an adversary from achieving the desired precondition and ultimately avoid a direct conflict.

All of the components of the space triad play a part in preserving US space advantage, thus avoiding a conflict on the adversary's terms. First, due to robust multi-tiered defensive options a potential adversary will have to employ a variety of techniques to attack US capabilities. Each means of attack, jamming, ground-based laser, direct ascent or co-orbital ASAT, computer attack, and so forth, carries its own intelligence and preparation requirements. The combination of preparations for a space attack coupled with the preparation for terrestrial

operations will undoubtedly raise warning flags for situational awareness to detect. With this warning, national and military leadership can plan and coordinate a variety of response options. Due to the adversary's use of space, one option includes holding their capabilities at risk. Should a determined adversary continue with their intentions, a responsive infrastructure will ensure any degradation to US space systems is short-lived and capabilities rapidly restored. The result is a disruption in the adversary's plan to deny US space capabilities and a prevention of their objectives.

While this short vignette represents an extreme case, many aspects are applicable to more likely scenarios. Certainly, as ASAT technologies proliferate, future crises will contain some level of threat to space capabilities. As this scenario illustrates, in the future conflicts, space will not only be an enabler for terrestrial operations, but may also play a decisive role in confrontations between political wills.

Implications of the Space Triad

Analysis of the space triad and its potential role in future crises identifies several implications for the development and sustainment of space power. Near-term implications largely center on changing perceptions of space power, its interaction with other domains, and how best to utilize space services. Mid-term implications focus on transforming the US's space power approach and joint space organizational culture. Finally, far-term implications deal with the need to solidify the transformation through organizational change.

Near-Term

Immediate implications deal with the DoD's perceptions of the cyberspace domain, space-derived services, and openness of space power capabilities. These perceptions unintentionally lead to inefficiencies and barriers to the full exploitation of space.

The concept of cyberspace including everything in the electromagnetic spectrum creates a span of authority too large to effectively manage. The DoD must responsibly pare down the definition of cyberspace to allow for a realistic operational approach. With this in mind, systems operating in other domains, whose primary function are to achieve a space effect, should be under the same development and control as pure space systems. For these reasons, the purview of space operations should include those cyberspace capabilities dedicated to achieving a space effect. Of course this does not mean those operations occur in isolation; they must be properly coordinated and integrated with other domain operations, to ensure maximum effectiveness and to minimize unintended interference.

The perception of space provided services as special or unique ultimately limits their full exploitation. As discussed earlier, space force enhancement and space force application missions are actually subsets of larger cross-domain operations. Views to the contrary support the development of stovepiped systems, making effective integration more difficult. The space community must recognize this fact to develop new systems and integrate capabilities accordingly.

Underpinning these misperceptions is a lack of openness about space capabilities. Internally, this lack of transparency hinders integration of capabilities and prevents adequate planning to maximize effectiveness and minimize limitations. Externally, it leads potential adversaries to misperceive US capabilities and intentions. While this may be advantageous in some respects, it ultimately degrades a deterrent strategy. The lack of transparency appears to stem from the two space sectors created by the space sanctuary doctrine. With the end of the Cold War and of the sanctuary doctrine, it seems time to set aside previous views and adopt a more open approach.

Mid-Term

With misperceptions clarified, the United States can move to transform its approach to space power. This transformation centers on the space infrastructure and organizational culture of the joint space professional cadre.

To overcome some of the previously identified internal challenges, greater emphasis is required in the R&D sector to mature technologies, prior to their infusion into space systems. Integral to the use of responsive boosters is a shift in the spacelift portfolio to include increased use of smaller payloads. This balanced approach will enable a larger variety of launch options, including emerging commercial capabilities. This shift of approaches will take time to fully implement, but efforts such as Tac-Sat and operationally responsive space are already leading the way.

Cultural transformation is needed to increase the integration of acquisition and operation professionals and the level of jointness in space power development. The space triad illustrates the acute relationship between space operations and acquisition. As a result of the Space Commission Report, AFSPC is responsible for Air Force space acquisition as well as space operations. Further, space acquisition personnel are part of the growing space professional cadre, able to wear the space badge and compete for command of operational squadrons. However, until an integrated career path for scientist, engineers, and space operators exists, there will be cultural barriers to the development of space power. To a lesser extent cultural artifacts such as uniforms and specialty codes, must also reflect a unified approach.[24] Finally, space professionals must embody a joint philosophy and outlook. Cultural parochialism must give way to reflect the interdependent reality of space operations. This must occur in all areas of the space triad to ensure capabilities are developed, fielded, operated, planned, defended, and implemented in a joint manner.

Far-Term

Enabled by accurate perceptions of space power and the establishment of a truly joint space culture, a new organization approach is the final step to realize the full potential of the space triad approach. As noted earlier the inception of NASA, parallel to the military's space efforts, was in large part due to the desire to make space a sanctuary.[25] Understanding space is no longer a safe haven, coupled with the need to be fiscally sound, the issue of organizational change rises. Beyond NASA

and the DoD, the myriad of agencies and organizations involved in space power conflicts with the concept of centralized control and creates organizational inefficiencies. While one single organization may be counter productive, some level of consolidation is warranted. A new organizational approach can streamline the space infrastructure, facilitate greater information sharing, provide robust defenses for all US space activities, and integrate offensive space capabilities to enable effective and efficient exploitation of the space domain.

Conclusion

Space is integral to the United States and the US cannot afford to delay action in dealing with the combination of external threats and internal challenges facing it. The US needs a single, joint approach to guide current operations and future space power development. The space triad is one approach and highlights critical areas for future space power discussions.

Only through the space triad construct can the US fully address all the critical factors associated with space power. Offensive capabilities are essential to shape the future operational environment and deny the advantages of space to future adversaries. The increasing reliance on space by the DoD and nation at large necessitates robust and multi-layered defensive capabilities. A responsive infrastructure is required to overcome acquisition difficulties and increase the flexibility of US space power to meet unforeseen challenges. Finally, an integrated core of cross-domain situational awareness, C2, and planning is critical to completely leverage all military and national capabilities to achieve the desired space power effects. If the United States is to maintain its preeminence in space, it must adopt the space triad.

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Maj Charles S. Galbreath (BS, Aerospace Engineering, Northrop University; MAS, University of Montana; MS, Space Operations, Air Force Institute of Technology; Masters of Military Operational Art and Science, Air University) is currently the program manager for Advanced Space Control Demonstrations at the Space Superiority Systems Wing, Space and Missile Systems Center (SMC), Los Angeles AFB, California. Prior to assuming his current position, he was a distinguished graduate at the Air Command and Staff College. Earlier he worked at United States Strategic Command as a space control capability officer. In this capacity he co-authored the Space Control Joint Capabilities Document and advocated for the command's space control requirements. Major Galbreath previously served as Chief Commander's Action Group, Space Warfare Center; Space Control Flight Commander, 17th Test Squadron; systems engineer analyst for Future Space, Developmental Planning directorate, SMC; and as Missile Operations flight commander and ICBM instructor, 12th Missile Squadron, Malmstrom AFB, Montana.

A Systematic Approach to Securing our Space Assets

Maj Heather Yates
Program Manager
Spacecraft Systems Integration
Headquarters National Reconnaissance Office
Chantilly, Virginia

Dr. Michael R. Grimaila
Associate Professor
Graduate School of Engineering and Management
Information Resource Management
Center for Cyberspace Research
Air Force Institute of Technology
Wright-Patterson AFB, Ohio

We are surrounded by the use of space assets, but for the most part are unaware of their impact on our lives. On a daily basis, space assets contribute to our well-being and others around the world. Space activities have enhanced security, monitored the environment, improved and increased information growth and flow, created economic growth, and changed the way people around the world live and work.[1] Since the 1991 Gulf War, we have also come to understand how much the US military depends on space. Military forces use satellite information for communications, intelligence, surveillance, reconnaissance, warning, weather, navigation, and timing. Space has become the ultimate high ground upon which we depend on militarily and as a nation. Because of this dependence, we must ensure our space assets are adequately protected. It is clear that a systematic approach to analyzing the security of our space assets is needed.

In this article, we draw upon the insights gained from the information security domain when developing strategies to secure organizational information assets; consider the application of Pipkin's five-phase information security process in the space operations domain;[2] and focus our discussion on the first phase of Pipkin's process, which is responsible for the identification, valuation, and assignment of safeguards to protect resources.

A Systematic Approach: Pipkin's Five Phases

In his book "Information Security: Protecting the Global Enterprise," Pipkin recognizes that information security is a critical success factor when securing an organization:

> Organizations can no longer regard security as an option, only needed for government contracts. Today's business environment makes security a requirement without which the company will most certainly suffer damaging losses.[3]

While Donald L. Pipkin's book focuses on the protection of business information systems, we believe that the lessons are equally applicable to Department of Defense (DoD) space systems. Military systems operate on the same information architectures as business systems, just with higher stakes if information becomes corrupted, lost, stolen, mismanaged, or unavailable. Just like in business, information is often the key determinate in the success or failure of military operations. Today, commanders rely upon information to make high quality decisions by accessing a greater number of information resources, obtaining more frequent updates from their information resources, and by correlation between, and across, multiple information resources to reduce uncertainty in the battlespace. As a result, we must recognize critical information assets and take steps to insure that they are protected at a level commensurate with their value.

Pipkin describes a cyclic, five-phase process to conceptualize the information security process: *Inspection, Protection, Detection, Reaction,* and *Reflection*. The *Inspection* phase requires the identification, valuation, and assignment of ownership of information assets critical to the organization; the *Protection* phase requires the assignment of the control measures to protect critical information assets commensurate with their value; the *Detection* phase requires the development of robust detection capabilities to insure that any breach of the organization is detected in a timely manner; the *Reaction* phase requires that the organization has developed the resources and capabilities to quickly respond, contain, investigate, and remediate breaches; and the *Reflection* phase requires effective post-incident documentation, reporting, and accountability to assure institutional learning. Neglecting any one of the five phases can expose the organization to excessive losses when they inevitably experience an information incident.

In the remainder of this article, we focus only on the first of Pipkin's five phases: the *Inspection* phase. Based upon our experience, we believe that this phase is the most important and most frequently overlooked. The *Inspection* phase is concerned with the evaluation of the capabilities of the organization; understanding and documenting its security needs; and assessing the current security capabilities to protect its assets. Specifically, we discuss the definition and identification of resources, threat assessment, vulnerability identification, evaluation of potential loss, assigning safeguards, and the evaluation of current status.

Defining DoD Space Resources

The first *Inspection* component requires us to define and identify our resources. Resources are defined as anything that adds value to the organization (or the country in this case) and whose loss would remove value. Information resources typically include all elements of an organization's information infrastructure including the systems, networks, and people. Anything that stores, transports, creates, or uses information in support of organizational objectives is a resource. Space sys-

tems resources include the three segments of space systems: the satellites themselves, the ground stations that operate and process the data, and the communication lines used in the exchange of information. They also include the people, infrastructure, and relationships which are harder resources to categorize and are often the resources that are not properly considered. An adequate identification of resources is required to evaluate risk and apply proper security measures.[4]

After making a formal inventory of DoD space resources, ownership and value must be assigned.[5] In some cases, ownership is an easy answer. In the new US National Space Policy, the secretary of defense and the director of national intelligence are assigned the duty of implementing procedures to "protect, disseminate and appropriately classify and declassify activities" to protect sensitive technologies, sources and methods, and operations.[6] Resource valuation is a much harder problem. Pipkin believes that the owner should determine the value of the resource. For military space systems the owner may be the best person to evaluate the type of investment made or the replacement cost, but not as good at determining the impact on the organization if the information we depend on from space is lost. It is important to note that the value comes not only from understanding how the resource is used in support of the owning organizational mission, but how others outside of the organization value the resource and how the owning organization benefits from the outside organizations use of the information. This is an important and often overlooked contribution to the value of a resource. It is also intimately tied to an understanding of the loss that would occur in the absence of the resource that we discuss below in our discussion of loss analysis.

Assessing Threats

The second inspection component requires us to asses the threats to our resources. A threat can be defined as a potential unwanted or undesirable event. A concise definition from the information technology security realm is given as: "A potential cause of an unwanted incident that may result in harm to a system or organization."[7] Threats can further be characterized by their source: natural, man-made, or technical. Man-made threats can be deliberate or non-deliberate.[8] A deliberate man-made threat can be defined as an expression of intention to inflict evil, injury or damage.[9] While it is possible to pre-emptively address some threats, in many cases threats are out of our control and cannot be totally eliminated. Interestingly, the Space Commission report identified an increase in threats to our space assets:

> The relative dependence of the US on space makes its space systems potentially attractive targets. Many foreign nations and non-state entities are pursuing space-related activities. Those hostile to the US possess, or can acquire on the global market, the means to deny, disrupt or destroy US space systems by attacking satellites in space, communications links to and from the ground or ground stations that command the satellites and process their data. Therefore, the US must develop and maintain intelligence collection capabilities and an analysis approach that will enable it to better understand the intentions and motivations as well as the capabilities of potentially hostile states and entities. An attack on elements of US space systems during a crisis or conflict should not be considered an improbable act. If the US is to avoid a "Space Pearl Harbor" it needs to take seriously the possibility of an attack on US space systems.[10]

Threats to DoD space assets affect the ground segment, communication link, and space segment or a combination of the above. Currently, the most significant deliberate threats to space systems are realized on the ground. These include threats to the physical, electronic, and information exchanges that involve the personnel, facilities, and ground segment equipment and the links to and from the space segment.[11] However due to technology sharing, material acquisitions and the purchasing of space services, threats to the space segment have increased and have started to overshadow the threats to the ground segment.[12] Air Force Doctrine Document (AFDD) 2-2.1, Counterspace Operations outlines some deliberate threats. These threats include:[13]

- Ground system attack and sabotage using conventional and unconventional means against terrestrial nodes and supporting infrastructure.
- Radio frequency (RF) jamming equipment capable of interfering with space system links.
- Laser systems capable of temporarily or permanently degrading or destroying satellite subsystems, thus interfering with satellite mission performance.
- Electromagnetic pulse weapons capable of degrading or destroying satellite and/or ground system electronics.
- Kinetic anti-satellite (ASAT) weapons capable of destroying spacecraft or degrading their ability to perform their missions.
- Information operations capabilities capable of corrupting space-based and terrestrial-based computer systems utilized to control satellite functions and to collect, process, and disseminate mission data.

In addition to the above threats, deliberate human acts can threaten the systems we use or the information related to the systems. Examples of deliberate human threats are espionage, sabotage, and information system attacks like worms, viruses or malicious computer attacks.[14] These threats are faced by business information security managers and are not unique to space systems. Private sector organizations must deal with these threats on a daily basis and are charged with protecting their organization from viruses, worms, Trojan horses, social engineering, phising, denial of service, theft of intellectual property, and failure of components. Therefore, we believe it is wise to draw upon the wealth of lessons learned from private sector organizations when securing our space assets.

Besides manmade threats, non-deliberate threats can also affect space assets. Natural threats are unpredictable and include meteor showers, inadvertent collisions of space objects, radio frequency interference, space environment phenomena, and natural destruction to ground systems. Again, just like information systems, space systems are composed of software, hardware, and infrastructure; all of which can fail.[15] A description of the threat and its likelihood assist with risk analysis and are used by the next component of the Inspection phase of security planning.

Identifying Vulnerabilities

The third inspection component requires us to identify vulnerabilities in our resources. A vulnerability can be defined as a weakness in a system that can be negatively affected or be exploited by some threat.[16] The keyword in the definition is "system" in its most general interpretation to include hardware, software, policies, procedures, and individuals. The definition covers flaws in the design of systems and their implementation, lack of rigorous policy and procedure statements, their inadequate implementation, and non-compliance. It is essential to realize that there are both known and unknown vulnerabilities. We can only address the vulnerabilities for which we are aware. For this reason, we must be proactive and continuously work towards the identification of unknown vulnerabilities. Mitigation of risk requires that we identify all potential vulnerabilities so that we can address them commensurate with their value.

Consider satellites which are built to withstand the rigors of launch and the harsh conditions of space. Yet they are relatively fragile objects. They are made of lightweight materials and are packed with sensitive equipment.[17] Our reliance on these complex objects makes us vulnerable to threats. One issue with vulnerabilities is we don't expect them to change or emerge, but they do. Upgrades, configuration changes, and new missions can add or change vulnerabilities. Just as security personnel continuously scan for threats, we must also plan for recurring vulnerability assessments.

For DoD space assets, the dependence upon access to space and the use of space is the biggest vulnerability. This vulnerability creates opportunity for adversaries to negatively impact DoD space capabilities.[18] Complicating this vulnerability is not having complete space situational awareness (SSA). SSA is having the insight into an adversary's space and counterspace operations. SSA requires understanding the current and future conditions, constraints, capabilities, and activities in, from, or through space. It includes understanding the space environment and its effects on our systems so we know if we have a deliberate threat.[19] To improve SSA, the Air Force is focusing on projects to improve our space surveillance capabilities. Projects include a space component, the Space Based Space Surveillance system, upgrading land based space surveillance network, and providing a decision making tool that recognizes attacks on satellites called the Rapid Attack, Identification, Detection, and Reporting System.[20] Former Air Force Chief of Staff, General John Jumper summed up this component of Inspection well:

> Identifying vulnerabilities will allow us to apply our full range of capabilities to ensure space superiority and continued support to joint military operations across the spectrum of conflict. Space superiority is as much about protecting our space assets as it is about preparing to counter an enemy's space or anti-space assets.[21]

Evaluating Potential Losses

The fourth inspection component requires us to evaluate the potential loss of the resources. Our space assets are used by commercial, civil, and military customers. Loss to civil and commercial customers is measured in financial terms; while loss to the military is measured in operational terms. In the case of the military, Mr. Tom Wilson, former Space Commission staff member, states, "as harmful as the loss or degradation of commercial or civil assets would be, an attack on intelligence and military satellites would be even more serious for the nation in time of crisis or conflict."[22] For the Space Commission report, Mr. Wilson came up with five types of losses that could result from an adversary's use of deception, disruption, denial, degradation, or destruction of specific space systems. They include:

- Impairment or elimination of reconnaissance satellites that would reduce SSA and could lead to military surprise, underestimation of enemy strength and capabilities, less effective planning, and less accurate targeting and battle damage assessments.
- Impairment or elimination of missile launch detection satellites that would degrade the US's ability to perform missile launch warning, missile defense, and would increase the psychological impact of the adversary's ballistic missiles.
- Impairment or elimination of satellite communications systems that would disrupt troop command and control problems at all force levels.
- Impairment or elimination of navigation satellites that would make troop movements more difficult, aircraft and ship piloting problematic, and could render many precision-guided weapon systems ineffective or useless.
- Impairment or elimination of Earth resource and weather satellites that would make it more difficult to plan effective military operations.[23]

The impact of possible attack depends on the importance of the resource, the timing, and duration of the loss.[24] Most space systems are truly "one of a kind assets" and as such are critical to mission success and hard to replace. While temporary denial may be worked around, the destruction of our assets would cripple our current capabilities due to the length in production time and response time to launch. In order to adequately provide SSA to commanders, it is essential for each organization to develop an understanding and document critical resource dependencies. This requires identification of all critical resources it relies upon, how and when the resources are used in support of their mission, and how the impact that would result from the loss of one or more resources. In theory, this sounds deceptively simple but in reality is much more difficult to calculate. In many cases, a qualitative assessment can be made by the decision makers who rely upon the resources, but such an estimate is of little value if it is not formally documented. Documentation ensures that the value estimate can be refined over time, provides transparency, reduces the time required to understand the impact of the loss of a resource, and reduces the variance in loss estimation that may occur when there is no documentation. The main idea is that we do not want to wait until we experience a loss to understand what value a resource provided to the organization. In the author's experience, we have seen far too many organizations that neglect to create and maintain this important

documentation. This is not due to ignorance, but instead it is often due to the difficulties in obtaining the required information, lack of personnel to collect and record the information, and fear that if the loss estimation is not properly secured it may be used as a targeting map by an adversary. Each of these impediments can be overcome if we are serious about securing our assets and we are willing to dedicate the time, personnel, money, and technology necessary to address them. Knowing the effects of a loss in military space capability (or our dependence on a resource) assists us in determining our vulnerability to the loss.[25]

Assigning Safeguards

The fifth inspection component requires us to assign safeguards, also known as controls, based upon the information collected during the first four Inspection components: the resources of interest, threats to the resources, the vulnerabilities inherent in the resources, and the loss of capabilities due to the loss of the resources. Assigning safeguards accurately is often difficult because it requires an accurate estimate of the costs to implement the safeguard, the value of the resource, the potential loss incurred if the resource is destroyed or degraded, the size and likelihood of the threats, and the size and likelihood of vulnerabilities. Using poor quality information leads to poor risk decisions and can result a non-optimal protection strategy. It should be noted that a non-optimal protection strategy does not always mean that resources are under protected, it can also mean that certain resources have been over protected at the expense of mitigating other significant risks. The overall goal in assigning safeguards is to identify the optimal protection strategy when constrained by a limited security budget. When assigning safeguards, tradeoffs must be made. Some important guidelines to consider are:

- Protective measures implemented must work together for full effect.
- Protection is only as good as the weakest link.
- Satellite survivability measures must be kept proportional to the value of the satellite's mission.
- Survivability must be kept proportional to the perceived threat.
- Safeguards must be weighed against their operational effects.[26]

Safeguards must be implemented to protect all segments of the resources or space assets. AFDD 2-2.1, Counterspace Operations, identifies Defensive Counterspace operations (DCS) as the ability to "preserve US/friendly ability to exploit space to its advantage via active and passive actions to protect friendly space-related capabilities from enemy attack or interference."[27] Friendly space related capability includes the ground system, communication links and satellites. DCS operations work to protect, preserve, recover, and reconstitute US and Allied space systems before, during and after an adversary attack.[28]

Passive safeguards serve to protect the assets. They are used to limit the effectiveness of the hostile action against the US system. Some passive safeguards identified in AFDD 2-2.1 are:

- *Camouflage, Concealment, and Deception (CC&D).* CC&D is most effective with terrestrial-based nodes. Certain types of ground-based components of space systems may operate under camouflage or be concealed within larger structures. These measures complicate adversary identification and targeting.
- *System Hardening.* Hardening of space system links and nodes allow them to operate through attacks. Techniques such as filtering, shielding, and spread spectrum help to protect capabilities from radiation and electromagnetic pulse. Physical hardening of structures mitigates the impact of kinetic effects, but is generally more applicable to ground-based facilities than to space-based systems due to launch-weight considerations. Robust networks, hardened by equipment redundancy and the ability to reroute, ensure operation during and after information operations attack.
- *Dispersal of Space Systems.* For space nodes, dispersal could involve deploying satellites into various orbital altitudes and planes. For terrestrial nodes, dispersal could involve deploying mobile ground stations to new locations.[29]

These passive DCS measures are layered together to form a defense. Besides passive DCS action, active DCS actions seek to remove or avoid the hostile effects. These active measures rely on early detection and characterization to be effective countermeasures. Active measures include:

- *Maneuver/Mobility.* Satellites may be capable of maneuvering in orbit to deny the adversary the opportunity to track and target them. They may be repositioned to avoid directed energy attacks, electromagnetic jamming, or kinetic attacks from ASATs. Today, maneuver capability is limited by on-board fuel constraints, orbital mechanics, and advanced warning of an impending attack. Furthermore, repositioning satellites generally degrades or interrupts their mission. The use of mobile terrestrial nodes complicates adversarial attempts to locate and target command and mission data processing centers. However, movement of these nodes may also impact the system's capability, as they must still retain line of sight with their associated space-based systems. Though the use of mobile technology is expanding, many of today's ground-based systems are not mobile, making physical security measures essential.
- *System Configuration Changes.* Space-based and terrestrial nodes may use different modes of operation to enhance survivability against attacks. Examples include changing RF amplitude and employing frequency-hopping techniques to complicate jamming and encrypting data to prevent exploitation by unauthorized users.
- *Suppression of Adversary Counterspace Capabilities (SACC).* SACC neutralizes or negates an adversary offensive counterspace system through deception, denial, disruption, degradation, and/or destruction. SACC operations can target air, land, sea, space, special operations, or information operations in response to an attack or threat

of attack. Examples of SACC operations include (but are not limited to) attacks against adversary anti-satellite weapons (before, during, or after employment), intercept of anti-satellite systems, and destruction of RF jammers or laser blinders.[30]

Other active DCS actions include actions that may target an adversary's counterspace capabilities. Such as using conventional and special operations forces to attack and disable an adversary's counterspace capabilities. Having a counterspace capability demonstrates a capability and willingness to counter their efforts deterring an adversary from attacking US/friendly space capabilities. Other safeguards include:

- A single integrated space picture would provide an accessible picture of global and theater space capabilities, threats and operations to commanders, planners, and combat forces, covering the full spectrum of friendly, adversary, and third party space systems. This would provide a comprehensive peacetime and wartime SSA capability, fusing information collected on all space systems, their ground, air, and space links and nodes to include their capabilities, status, vulnerability, and users.
- Physical security systems provide security and force protection for critical ground facilities and equipment. A complementary mix of technology and security forces can effectively and efficiently mitigate specific threats in an ever-changing environment. When properly deployed and utilized, physical security systems can represent an effective deterrent and provide aggressive defense against terrestrial node attack and sabotage.
- Air defense assets are capable of protecting launch and terrestrial nodes from air or missile attack. If threatened, commanders should consider deploying air defense assets such as fighter aircraft, surface-to-air missiles, and/or antiaircraft artillery to protect critical space assets (e.g., facilities and infrastructure). A sound air defense may deter an adversary and most certainly will be instrumental in defending our forces and assets if an attack is attempted.
- Attack detection and characterization systems detect space system attacks and provide information on the characteristics of the attack, especially if the source and/or capability of the attack is unknown or unexpected. These systems will support locating the source of the attack and the type of weapon used in the attack. They may be ground-, air-, or space-based and either integrated with systems they protect or used in a stand-alone capacity. Having our adversaries aware of these capabilities may influence their decision and act as an effective deterrent.
- Survivability countermeasures ensure critical space systems continue to operate both during and after attack. Examples include (but are not limited to): spacecraft system hardening, redundant systems (both on spacecraft and in ground stations), spacecraft maneuverability, ground station mobility, and jam-resistant communication links. Known survivability measures may deter an adversary from attacking our space capabilities.[31]

Evaluating the Current Status

Currently there are more than 450 active foreign spacecraft in orbit, and that number is expected to reach 600 by 2010.[32] With this increase in foreign satellites, there will be new imaging, environmental and even navigational satellites entering the mix. "Many countries are developing advance satellites for remote sensing, communication, navigation, imagery, and missile warning. The increase in the number and capability of these satellites enhances a country's command, control, communication, and computers intelligence, surveillance, and reconnaissance capabilities and in turn their warfighting capability" which changes the environment we operate in.[33] As this mixture changes, we must monitor this environment and our security, which is the last component of inspection. Evaluating the effectiveness of current processes requires periodic analysis of procedures and testing. If possible a complete evaluation of the system needs to be done from the perspectives of satellite to the communication links to the ground station and finally the deployment of the information. An evaluation is required on the physical security, personnel policies and practices, business processes, backup and recovery measures, and network controls to include our operations security and information assurance, as noted in AFDD 2-2.1:

> Operations security (OPSEC) and information assurance (IA) protect our space systems by limiting the availability of information on their operations, capabilities, and limitations to our adversaries. IA protects critical computer systems from intrusion and exploitation. Guiding adversaries' actions can successfully deter effects on our space services, but OPSEC and IA operations are primarily focused on defending our assets from attack.[34]

Along with a review of our procedures, testing must be done to identify additional resources, threats, and vulnerabilities. We currently test only individual aspects of DoD space systems. We have inspections that test the security of certain bases or facilities but not the system as a whole. This is an area that could be improved—the integration and testing of our space capabilities across the complete space spectrum. A representative of the Langfang Army Missile Academy has said, "In future space wars, the main operations will consist of destructive satellite attacks and counterattacks, as well as jamming and antijamming operations."[35] In other words, the threat is real and will continue to grow making it necessary to continuously monitor the situation.

Conclusion

Inspection is just one aspect of a robust security program. We have found that while we do a good job at protection, detection, and reaction to security incidents; we often fail to do well during the first phase *Inspection* and the last phase *Reflection*. There has been a significant amount of research in the individual components of *Inspection*—resource definition, threat assessment, loss analysis, vulnerabilities identification, safeguard assignment, and evaluating the current status that can be applied to DoD space assets. But we think it is vital to look at the whole picture to ensure there are no security gaps. President George W. Bush believes our top goal is to "strengthen

the nation's space leadership and ensure that space capabilities are available in time to further US national security, homeland security, and foreign policy objectives and to enable unhindered US operations in and through space."[36] The first step in ensuring DoD space superiority is a systematic inspection of DoD space assets.

Notes:

[1] *US National Space Policy,* Authorized on 31 August 2006 and supersedes Presidential Decision Directive/NSC-49/NSTC-8, National Space Policy, 14 September 1996.

[2] Donald L. Pipkin, *Information Security Protecting the Global Enterprise,* Hewlett-Packard Company, 2000.

[3] Ibid., 17.

[4] Pipkin, *Information Security.*

[5] Ibid.

[6] *US National Space Policy,* 9.

[7] ISO/IEC 13335:1996, "ISO/IEC Information technology—Guidelines for the management of IT Security – Part 1: Concepts and models for IT Security." ISO/IEC 13335, 1996.

[8] Pipkin, *Information Security.*

[9] *Merriam-Webster's Collegiate Dictionary,* Tenth Edition, 2002.

[10] *Report of the Commission to Assess United States National Security Space Management and Organization,* Space Commission, Pursuant to Public Law 106-65, 11 January 2001, 8.

[11] Adolfo J. Fernandez, *Military Role in Space Control: A Primer,* Congressional Research Service Report to Congress, 23 September 2004.

[12] National Air and Space Intelligence Center (NASIC)-1441-3894-05, *Challenges to US Space Superiority,* March 2005.

[13] Air Force Doctrine Document (AFDD) 2-2.1, *Counterspace Operations,* Air Force Doctrine Center, 2 August 2004, 4.

[14] Pipkin, *Information Security.*

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[16] ISO/IEC 15947:2004, "ISO/IEC Information technology—Security techniques - IT intrusion detection framework." ISO/IEC 15947, 2004.

[17] Paul Stares, *Space and National Security,* The Brooking Institution, 1987.

[18] Maj Gen Shelton, 14AF CC, speech, briefed to IDE class at AFIT, 15 November 2006.

[19] AFDD 2-2.1, *Counterspace Operations.*

[20] John A. Tirpak, Securing the Space Arena, *Air Force Magazine,* July 2004.

[21] AFDD 2-2.1, *Counterspace Operations,* 1.

[22] Tom Wilson, *Threats to United States Space Capabilities,* Space Commission Staff Member, http://www.fas.org/spp/eprint/article05.html, section V.

[23] Ibid.

[24] Pipkin, *Information Security.*

[25] Ibid.

[26] Stares, *Space and National Security.*

[27] AFDD 2-2.1, *Counterspace Operations,* 31.

[28] Ibid.

[29] Ibid., 26.

[30] Ibid., 27.

[31] Ibid., 28.

[32] NASIC, 10.

[33] Ibid.

[34] AFDD 2-2.1, *Counterspace Operations,* 29.

[35] National Air and Space Intelligence Center, 16.

[36] Mark Kaufman, "Bush Sets Defense As Space Priority: US Says Shift is Not a Step Toward Arms, Experts Say It Could Be," *Washington Post,* 18 October 2006.

Maj Heather H. Yates (BS, Applied Mathematics, University of Virginia; MS, Management, Troy State University; MS, Systems Engineering, Air Force Institute of Technology (AFIT)) is program manager, Spacecraft Systems Integration, Headquarters National Reconnaissance Office, Chantilly, Virginia. She directs the technical activities of a major contractor systems engineering team building advanced spacecraft and subsystems components.

Major Yates was commissioned through ROTC at the University of Virginia in May 1994. She has served a variety of space/missile operations and acquisition positions. Her initial assignment was to Malmstrom AFB, Montana where she served as a Minuteman III combat crew commander, evaluator, and instructor. At the 11th Space Warning Squadron, Major Yates was responsible for all contract issues for the Attack and Launch Early Reporting to Theater (ALERT) system and was qualified as a theater warning crew commander. Major Yates transitioned from operations to acquisition at the Space and Missile Systems Center, where she was responsible for the Space-based Infrared Satellite System (SBIRS) International Affairs, SBIRS Mission Processing Development and was the SBIRS and Military Satellite Communication staff director for the Program Executive Officer (Space). Prior to her current assignment, Major Heather Yates completed Intermediate Development Education at AFIT and earned the "Distinguished Graduate" award.

Dr. Michael R. Grimaila (BS, Electrical Engineering; MS, Electrical Engineering; and PhD, Computer Engineering, all from Texas A&M University) is an associate professor and a member of the Center for Cyberspace Research at the Air Force Institute of Technology, Wright-Patterson AFB, Ohio. He is a CISSP, CISM, GSEC, and holds the NSA IAM and IEM certifications. He teaches and conducts research in the areas of information assurance, information warfare, and information operations. Dr. Grimaila serves on the Editorial Advisory Board of the ISSA Journal, on the ISACA Security Program Metrics Project, and is a member of the DoD/NII Information Assurance Best Practices and Security Metrics Working Groups. He is also a member of the ACM, IRMA, ISACA, ISC2, ISSA, ISSEA, the SANS Institute, and is a senior member of the IEEE.

Brave New War:
The Next Stage of Terrorism and The End of Globalization

Brave New War: The Next Stage of Terrorism and The End of Globalization. By John Robb. New Jersey: John Wiley & Sons, Inc., 2007. Pp. 208. $24.95 Hardback ISBN 978-0-471-78079-3

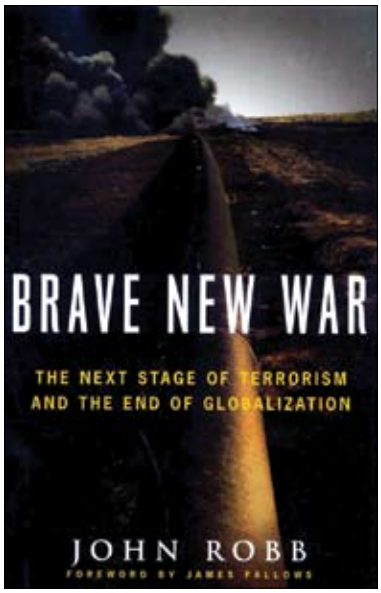
Each war is different from all the wars that have preceded it, and the global war on terrorism (GWOT) is no exception. The weapons and tactics employed in each war are a product and reflection of the times. Looking back, mass warfare characterizes the Napoleonic and US Civil Wars. World War I was an industrial war—a battle of attrition. Total War would characterize World War II as the Axis and Allies fought from one corner of the globe to another. The decisiveness of the 1991 Gulf War was aided by space capabilites. And most recently, the engagements in Afghanistan against the Taliban and the liberation of Iraq are essentially the culmination of all the preceding improvements in employment and tactics of the modern military force.

While unique in their execution, all of these wars share the common thread of a clearly defined adversary. This is not the case in the GWOT. There is not a single nation rattling its saber and there is not a single leadership entity to oust. This is a central tenant in John Robb's work, *Brave New War.*

The war against terrorism is unlike any war in modern history, and, according to *Brave New War*, the tactics leaders are employing are not sufficient to deal with the threat at hand; the tactics being employed hearken back to two clearly defined nation states battling over physical territory or resources. What is being overlooked by leadership is that this is a war between ideologies which requires a new set of tactics, this is precisely John Robb's controversial point.

A graduate of the US Air Force Academy and Yale University, John Robb is an expert in counter terrorism and is a former operational commander. At first glance, some who disagree with Robb would say he is merely encouraging troop withdrawals in what is becoming a publicly unpopular war. But this would be a gross mischaracterization of Robb's work.

Robb draws a startling comparison of the Cold War to the GWOT. At the core, the United States won the Cold War by outspending its adversary, bankrupting the USSR in an arms race. Robb contends that if we continue down our current path the same will happen to the United States. Al-Qaeda's success, in monetary terms has been staggering; an attack on an oil pipeline in Iraq that cost al-Qaeda an estimated two thousand dollars yielded more than $500 million in damages and lost revenue. The attack on 9/11 is estimated to have cost al-Qaeda as little as $250,000; this attack generated an astronomical return for al-Qaeda's investment by costing the United States more than $80 billion, which does not include any of the downstream costs, estimated to be as high as $500 billion, in additional security measures.



In drawing comparisons between contemporary issues with the GWOT and lessons learned throughout history, Robb illustrates, as he sees it, an outline of the current state of affairs, including the political ramifications, the economic implications, and the cultural impact that the deployment of United States military is having both at home and abroad. He proposes alternative courses of action for the United States that would minimize the potential exposure to al-Qaeda's threat. He explains how al-Qaeda is using our own strengths against us and how we need to shift our strategy to compensate for these vulnerabilities. Robb sights examples of recent introductions in net-centric warfare and our reliance on other new and highly evolved technologies as some of our greatest strengths while simultaneously being our greatest vulnerabilities.

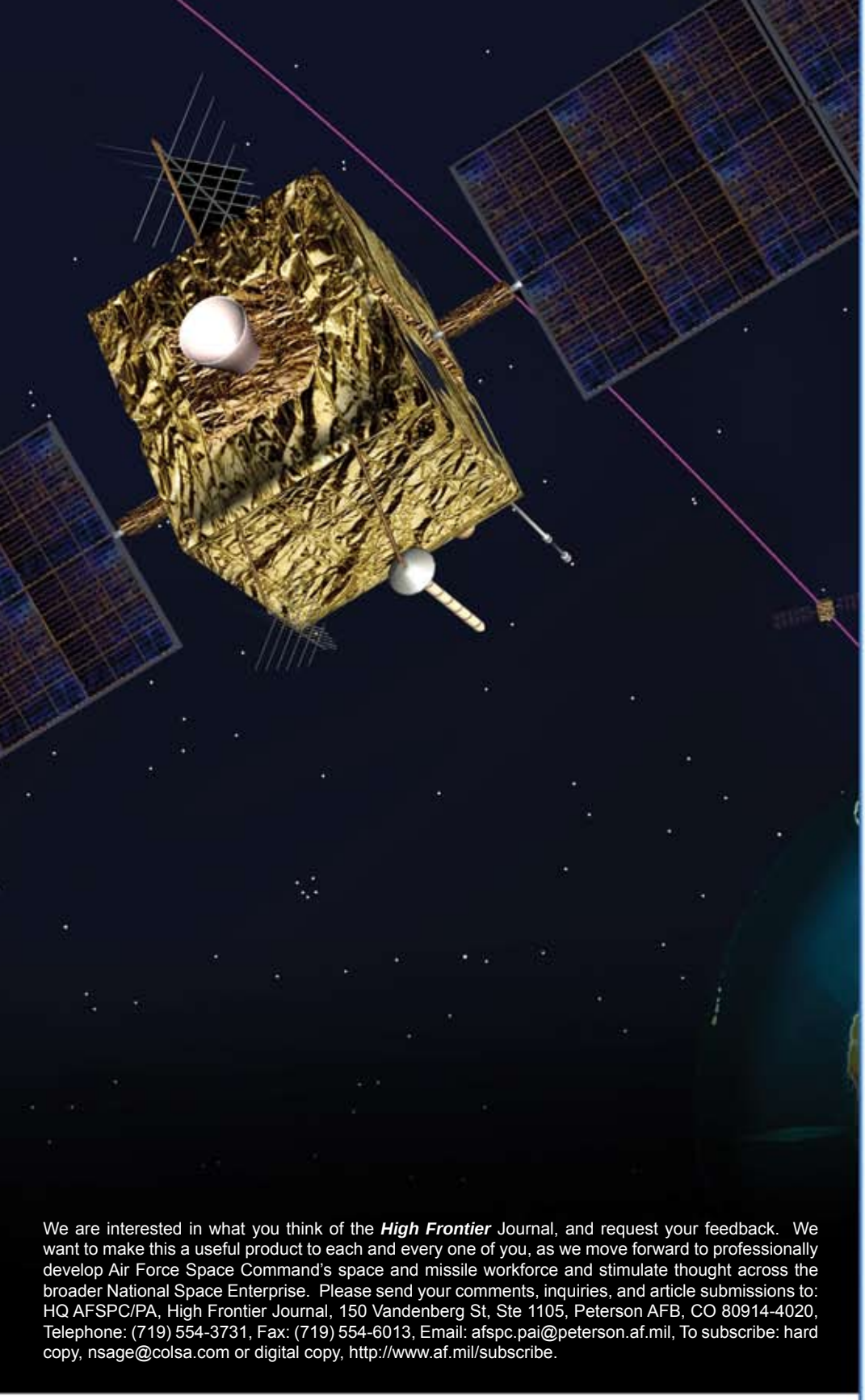
To mitigate the vulnerabilities that al-Qaeda are determined to exploit, Robb puts forth a convincing argument that a paradigm shift in the way we think of the GWOT is needed. Without a major shift in how we think of the war, and how we think and deal with our adversary, our way of life and our success is in jeopardy. Robb asserts that if we continue to treat the GWOT as previous wars, that of a war over geographical territory and economic resources, we will not succeed. Instead, it is a war of ideologies that requires a new set of tactics to wage. It is not a war over territories and resources, not acres of land and access to energy, but the hearts and minds of people around the world. This will not be a war won in just a few months. Ideologies are grown over a number of generations, they have an inherent momentum. The rules of Newtonian physics apply in this situation, albeit metaphorically. It will take time and energy to counteract the moving mass of an adversarial ideology to a path where it is no longer contradictory.

For the warfighter there is a central tenant to take away from this book, that we must not continue to say that the emperor's new clothes look great when in fact he is not wearing any. As those in the profession of arms must remain vigilant, ever aware of the threat that lurks just beyond the horizon. While Robb's thesis is primarily directed at the decision makers his point is not wasted on the warrior.

The bottom line, as John Robb sees it, the United States and the free world must shift how we think of the GWOT. It is an ideological war not territorial; it is a war of attrition where our adversaries have clearly stated that they intend to deplete our resources at an astronomical rate; and it is a war where we are vulnerable if changes are not made in how we consider, define, engage, and defend against an enemy that intends to destroy our way of life.

In his final thought in *Brave New War*, Robb says, "[b]ecause we are unable to decapitate, outsmart, or defend ourselves against global guerrillas, … we need to learn to live with the threat they present. … It does mean the adoption of a philosophy of resilience that ensures that when these events do occur (and they will), we can more easily survive their impact."

Reviewed by Capt Thomas A. Trask, USAF, PAVE PAWS Crew Commander, 6th Space Warning Squadron, Cape Cod AFS, Massachusetts.



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AFSPC/PA
150 Vandenberg St.
Ste 1105
Peterson AFB, CO 80914
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Fax: (719) 554-6013

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